

As per letter No. AA/100/2018-19/780
dt. 12/12/2018.

UNIVERSITY OF MUMBAI

No. UG/95 of 2018-19

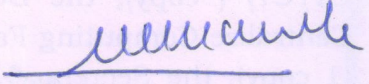
CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/253 of 2008, dated 16th June, 2008 relating to syllabus of the Bachelor of Engineering (B.E.) degree course.

They are hereby informed that the recommendations made by the I/c Dean, Faculty of Science and Technology in Mechanical Engineering at its meeting held on 9th April, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 vide item No. 4.58 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.E. (Printing & Packaging Technology Engineering) Sem. V & VI has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI - 400 032

To ~~July~~ 2nd August 2018


(Dr. Dinesh Kamble)
I/c REGISTRAR

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.58/05/05/2018

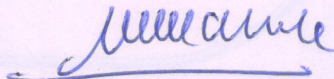
No. UG/95 -A of 2018

MUMBAI-400 032

2nd August,
July, 2018

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Director, Board of Examinations and Evaluation,
- 3) The Director, Board of Students Development,
- 5) The Co-Ordinator, University Computerization Centre,


(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI



Bachelor of Engineering

Printing & Packaging Technology

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

Third Year Syllabus with Effect from AY 2018-19

under

FACULTY OF TECHNOLOGY

**As per Choice Based Credit and Grading System
with effect from the AY 2016–17**

Dean, Faculty of Science and Technology

Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development. Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs) and give freedom to affiliated Institutes to add few (PEOs). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, semester-based credit and grading system is also introduced to ensure quality of engineering education. Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scales to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc. Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017- 18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Dean (I/c) Faculty of Science and Technology,

Member - Academic Council,

University of Mumbai, Mumbai

PRINTING & PACKAGING TECHNOLOGY: CBCGS 2016 T.E. - PPT

SEMESTER – V																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Metho d	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme							Total Marks
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment						End Sem Exam	
											T1	T2	Av.					
V	PPC501	Plastics Processing & Conversion Technologies	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC502	Gravure Printing	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
V	PPC503	Theory of Machines & Design	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC504	Instrumentation & Process Control	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
V	PPC505	Industrial Products Packaging	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
V	PPL501	Plastics Processing & Conversion Technologies Laboratory	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
V	PPL502	Package Design & Graphics - I	TW/Pr	-	-	3	-	-	1.5	1.5	-	-	-	-	25	25	-	50
V	PPL503	Theory of Machines & Design Laboratory	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
V	PPL504	Instrumentation & Process Control Lab	TW	-	-	2	-	-	1	1	-	-	-	-	25	-	-	25
V	PPL505	Business Communication & Corporate Ethics	TW	-	-	4*	-	-	2	2	-	-	-	-	50	-	-	50
TOTAL				18	0	14	18	0	7	25	-	-	100	400	150	25	25	700

SEMESTER – VI																		
Sem	Paper Code	Paper Name (As displayed on Mark Sheet)	Asses- ment Method	Teaching Scheme (hr/wk)			Credits Assigned				Examination Scheme							Total Marks
				L	T	P	L	T	P	Total	Theory Marks			Term- work	Prac- tical	Oral		
											Internal Assessment						End Sem Exam	
											T1	T2	Av.					
VI	PPC601	Packaging Machineries & Systems	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VI	PPC602	Food & Pharmaceutical Packaging	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPC603	Flexographic Printing	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPC604	Colour Management	Theory	3	-	-	3	-	-	3	20	20	20	80	-	-	-	100
VI	PPDE601X	Department Elective – I	Theory	4	-	-	4	-	-	4	20	20	20	80	-	-	-	100
VI	PPT601	Packaging Machineries & Systems	TW/Or	-	2	-	-	2	-	2	-	-	-	-	25	-	25	50
VI	PPL601	Package Design & Graphics - II	TW/Pr	-	-	4	-	-	2	2	-	-	-	-	25	50	-	75
VI	PPL602	Flexographic Printing Laboratory	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25		25	50
VI	PPL603	Colour Management Laboratory	TW/Or	-	-	2	-	-	1	1	-	-	-	-	25	-	25	50
VI	PPDET601X	Department Elective – I Tutorial	TW/Or	-	1	-	-	1	-	1	-	-	-	-	25	-	25	50
VI	PPS601	Industrial Visits	TW/Or	-	-	3	-	-	1.5	1.5	-	-	-	-	25	-	25	50
TOTAL				18	3	12	18	3	6	27	-	-	100	400	150	50	100	825

Department Electives – I: 1. Packaging Distribution & Dynamics 2. Inks & Coatings 3. Digital & Security Printing 4. Print Finishing & Converting

GENERAL GUIDELINES FOR ALL COURSES:

Theory Examination (End Semester Examination) for 80 Marks:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total 4 questions are needed to be solved.
3. Question No.1 will be compulsory and based on entire syllabus.
4. Remaining questions will be randomly selected from all the modules.

Internal Assessment for 20 Marks:

Compulsory Test-1 will be conducted (on minimum 40% of curriculum) and Test-2 can be class test (on minimum 60% of curriculum) or assignment on live problems or course project.

Termwork for Laboratory / Tutorial:

The distribution of term work marks (in courses not mentioned) is as follows:

Assignments:	05 Marks
Practical Journal/Tutorials & Continuous Assessment:	15 Marks
Attendance:	05 Marks

Course Code	Course Name	Credits
PPC501	Plastic Processing and Conversion Technologies	4

Objectives:

1. To study different plastic processing and conversion techniques
2. To know suitable processing technique as per the end product
3. To study Polymer & Plastic properties influencing conversion techniques
4. To get acquainted with various plastics used in day-to-day life
5. To study and analyse different tests for plastic product

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

1. Describe the fundamental concepts in plastic processing and conversion technology.
2. Analyse the various plastic materials and its application
3. Understand and use suitable conversion technique as per the end product
4. Produce plastic products by using various conversion techniques
5. Perform different testing methods for plastic product
6. Study different processing parameters required in industry

Module	Details.	Hrs.
1	Introduction Basic concept of polymer processing, Polymer additives, Polymer properties influencing conversion technologies Thermal properties – melting temperature, the glassy state and glass transition, molecular weight distribution, MFI, HDT	3
2	Plastic Extrusion Basic Principle of extrusion, extruder parts, types of extruder, process, process variables, Extrusion single screw - machine and equipment Extrusion twins screw - machine and equipment, types- intermeshing, non-intermeshing, co-rotating, counter rotating, comparison single screw and twin screw, Extrusion Process – detail of screw geometry and die, melt filters, breaker plate, selection of process and product, extrusion of film and sheet, common defects and remedies, Die end of extruder, melt flow in extruder, die configuration and extruded products	10
3	Plastic Injection Moulding Principle, Machine, Processing, Process variables, mould cycle, Types of injection mould – cold runner mould, two plate mould, three plate mould, insert mould, hot runner mould, Injection moulding product design tips and guidelines, injection moulding defects and troubleshooting, weld line, shrinkage-warpage, burn marks venting, application of injection moulding in packaging – caps, closures, containers, drums etc.	10
4	Rotational Moulding Technology Rotational moulding principle, machine type, process, process parameters, Importance of resin charge, troubleshooting causes and remedies, Advantages and Disadvantages	5
	Thermoforming Technology	

5	Vacuum thermoforming, pressure thermoforming, matched mould thermoforming, twin sheet thermoforming, thermoforming moulds	5
6	Blow Moulding Technology Extrusion blow moulding, Injection blow moulding, Injection stretch Blow moulding, Blow moulding machine features and operation, parison programming, accumulator head blow moulding, multilayer blow moulding, common troubleshooting causes and remedies, limitations of blow moulding	6
7	Calendaring and Metallization Principle and process description, Types of calendaring unit (L type, I type, Inverted L type etc., Metallization process, equipment - vacuum metallization with aluminium and silica	4
8	Compression and Transfer Moulding Compression moulding -process, materials, advantages and disadvantages, Transfer moulding -process, materials, advantages and disadvantages, Applications of compression and transfer moulding	5

References:

1. A Brent Strong, "Plastic Material & Processing", Pearson Prentice Hall
2. Rosato D. V., "Extruding Plastic-A Practical Processing Handbook", Chapman Hall
3. Rosato D. V., "Blow Moulding Handbook", Hanser Publication
4. Harold F. Giles, Jr., John R. Wagner, Jr., Eldridge M. Mount, "Extrusion-The Definitive Processing Guide and Handbook.
5. Crawford R.J., Throne J. L., "Rotational Moulding Technology", William Andrew Publishing
6. James L. Throne, "Technology of Thermoforming", Hanser Gardner Publication

Course Code	Course Name	Credits
PPC502	Gravure Printing	3

Objectives:

1. Understand the basic principle of Gravure printing process and its characteristics
2. Study the gravure image carrier preparation methods
3. Learn the various operations involved gravure printing process

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

1. Describe the various components of gravure printing machine and its functions.
2. Explain various design aspects gravure cylinder and the process of engraving it.
3. Summarize the various operations performed while printing on Gravure machine
4. Discuss various inks and substrates used for gravure process with quality control measures
5. Describe various web handling and registration control for gravure printing
6. Calculate the different anatomy of gravure cylinder

Module	Details	Hrs.
1	Introduction, History and Gravure Products Characteristics of Gravure printing-comparison with other processes, History of Gravure product and Market-Publication gravure, Gravure packaging and converting, Product gravure Gravure development stages- Use of Engravings, Roulette tool, Rotary press invention, Aquatint process, Diffusion etch (carbon tissue) process, Direct transfer process, Well formation, Cylinder proofing and correction, Advances in Engraving and Cylinder Imaging.	6
2	Gravure Cylinder engraving Cylinder Construction- Cylinder design, Sleeve cylinders, Integral shaft cylinder, Base material, Surface material, Deflection, Balancing, Function of Copper, Chrome, Zinc, Principle of Electroplating, Basic design of plating tank, Important variables in plating Electronic Engraving Systems- Electromechanical engraving machine, Cutting action of diamond tool, Variable cell size, Cell alignment, Cell walls, Screen and Screen angles, Ink and Substrate considerations, of cell size to dot size, UCR, Fine line production Chrome plating, Chrome finishing, Cylinder corrections- correction in chrome, correction in copper, Measurement and Testing	9
3	Gravure Press and its components A general printing unit, Typical press configurations, Gravure ink fountain-ink fountain and ink transfer, Ink temperature, Ink viscosity Gravure Ink dryers- Need, Solvent removal, drying of water based inks, dryer functioning, Environmental considerations The gravure doctor blade-Setup, Pressure, cylinder considerations, doctor blade Material, Variations in doctor blade usage	9

	Gravure Impression roller- Functions, Roller design and configuration, Deflection, Roller covering, Coating and Hardness, Impression roller and print quality, Effect on web, Electrostatic Assist	
4	Web Handling Configuration, Reel stands, and Register control-Unwind Reel stand, Control of web tension from the reel, Web tension control-Zone concept, The effect of the printing unit on Tension, Cylinder progression, Register, Reasons for misregister, Tension measurement, Automatic register control, Lateral movement of the web and side register control, Trends in register control, Web viewing	7
5	Gravure Ink and Substrates Ink Composition, Classification of Gravure Inks, Special inks and coating, water-based inks, Physical properties of Gravure inks, Ink test and Measurement, Problems and trouble shooting Gravure packaging paper substrates- Packaging substrate requirements, Label stock, Paper board, Run ability Tests, Print quality Tests, Waste and Spoilage Gravure non-paper substrates-Types, Properties- Physical properties, Appearance, primer and overprint coatings, Surface Versus reverse Printing, Problems and trouble shooting	5

References:

1. Gravure Education Foundation And Gravure Association of America, "Gravure Process and Technology" Edition 2003
2. J. Michael Adams, Penny Ann Dolin, "Printing Technology 5E", Delmar Publishing 5th Edition
3. Basic Gravure Technology, PIRA
4. H. Kipphan, Handbook of print Media, ISBN: 3-540-67326-1 Springer-Verlag Berlin Heidelberg
5. Ronald E. Todd, (1994), Printing Inks: Formulation Principles, Manufacture and Quality Control, Pira International

Course Code	Course Name	Credits
PPC503	Theory of Machines and Design	4

Objectives:

1. Develop an ability to understand the working of mechanisms in machine.
2. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints for various mechanical components.
3. Develop an ability to identify and solve mechanisms in machine

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

1. Analyse the stresses and strains in mechanical components, and understand, identify and quantify failure modes for mechanical parts.
2. Describe the basic machine elements used in machine design.
3. Design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
4. Develop the approach to design the component under realistic conditions.
5. Design Machine element against static loading
6. Develop the ability to design the component under realistic conditions

Module	Details	Hrs.
1	Basic concept and straight-line mechanism Introduction to machines, Mechanisms, Joints, links. Types of kinematic pairs and motions. Degree of freedom, Constrained kinematic chain mechanism. Single slider crank chain, pantograph mechanism, Double slider crank chain mechanism, Straight line mechanism (Exact and approximate).	06
2	Motion characteristics of mechanisms Velocity and acceleration analysis of mechanisms with single degree of freedom using graphical method. Kennedy 's theorem Analysis of velocities of mechanism using instantaneous centre method.	08
3	Introduction to CAM and followers Introduction and Classification of follower & CAMS. Displacement, velocity and acceleration diagrams when: Follower moves with uniform velocity, SHM, acceleration and retardation, cycloidal motion and Construction of CAM profiles.	10
4	Basic concepts and principles of machine design Classification of engineering materials, Basic procedure of machine design. Mechanical properties of metals, Basic requirements of machine elements. Selection of materials and its types. Stress strain diagram. Factor of Safety (FOS), Selection of FOS. Principal stresses and Theories of Failures.	08
5	Design against static loading Cotter joint, Knuckle Joint, Welded joint	08

6	Design of Keys, Shaft and coupling Taper Keys, Gib headed keys, Parallel Keys, woodruff key.Design of Flange Coupling. Shaft and its types, Shaft design on strength basis, Shaft design on torsional rigidity basis.	08
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References:

1. “Design of machine elements“ by V.B. Bhandari
2. “Design data book” by K. Mahadevan and K. Balareddy
3. “Textbook of Machine design” by R.S.Khurmi and J.K.Gupta

Course Code	Course Name	Credits
PPC 504	Instrumentation and Process Control	4

Objectives:

1. To generate clear understanding of fundamentals of basic measuring devices.
2. To provide details of data gathering, processing and computing.
3. To make students familiar with the various methods of process control

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

1. Knowledge of measuring devices and signal conditioning will help students to select the correct transducer as per the requirement.
2. Students will be able to confidently design a PID controller using opamps or through MATLAB program.
3. The understanding of applications of PLC's in latest printing machines and also packaging machines will be developed.
4. Understand applications of PLC's in industries and printing and packaging machines.
5. Explain PLC and SCADA systems and their use in process control.
6. To Understand and formulate various applications like DAS and data logger

Module	Details.	Hrs.
1	Measurement and Transducers Measurement: Introduction to the concept of measurement, basic characteristics of a measuring device, block diagram of measuring system, error and its types Transducers: Need of transducer, definition, classification, selection criteria Quantities to be measured: displacement (LVDT, Potentiometer), flow (Rotameter, electromagnetic flowmeter), light (LDR), level (radiation method, ultrasonic method) temperature (RTD, thermocouple), humidity (condensation hygrometer), pressure (bourdon tube, liquid column), strain gauges and their classification, derivation of gauge factor, pH measurement using hydrogen electrode method, sensors and their comparison with transducers	09
2	Signal Conditioning Definition of signal conditioning, its need, introduction to op-amp IC-741, inverting and non-inverting amplifier in closed loop, differential amplifier, instrumentation amplifier, filters (active, passive, low-pass, high-pass), adder, subtractor, V to I converter, I to V converter, introduction to IC-555, astable mode and its application as square wave oscillator, mono stable mode and its applications as frequency divider and missing pulse detector, bi-stable multi-vibrator.	08
	Control System Dynamics Introduction to control engineering, open loop and closed loop system, classification of control systems, LTI system, Concept	06

3	of stability and causality, Role of a control engineer, Importance of mathematical modelling, Block diagram of basic control system, Transfer function, Test input signals, Time domain response: Transient response specifications and Steady state error for various input signals, frequency-domain specifications, hydraulic system, pneumatic system, control system components: AC and DC servomotor, stepper motor	
4	Process control Block diagram of Process control, Process characteristics, Control system parameters, role of a controller, Controller modes: Discontinuous: Two position, multi-position, floating, Continuous and Composite: Proportional, Integral, Derivative (description only for all modes), block diagram of final control operation	08
5	Controller design Concept to electronic controller and use of OP-AMP in controllers. Design of all Discontinuous modes using OP-AMP. Design of all continuous controller modes using OP-AMP and derivations for final outputs. Design of all Composite modes using OP-AMP and derivations for final outputs with examples for each mode.	09
6	Programmable logic controller Concept of relay logic, introduction to ladder diagram and its elements, illustration of ladder diagram with examples, introduction to PLC, advantages of PLC over relay logic, introduction to DAS, data logger, SCADA. Application of PLC in pad printing machine. PLC controlled automatic packaging machine.	08

References:

1. C.S. Rangan, G.R. Sarma, "Instrumentation devices and systems" TMH.
2. A.K.Sawhney, "Electronic and Electrical measurements and instrumentation", DhanpatRai and CO.
3. H.S.Kalsi, "Electronic Instrumentation", TMH.
4. Johnson, "Process Control Instrumentation Technology", Pearson Education.
5. Norman.S.Nise, "Control Systems Engineering", Wiley Publications

Course Code	Course Name	Credits
PPC 505	Industrial Products Packaging	3

Objectives:

1. Study the classification, characteristics & sensitivities of various industrial products.
2. Understand package design & development approach based on the type of industrial product.
3. Study the classification and properties of wood, including the defects.
4. Study the different wood-based packaging forms and other bulk carriers.
5. Understand the product protection principles.

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

1. Effectively choose packaging materials based on characteristics of industrial products.
2. Describe the various properties & defects of wood packaging material
3. Analyse the various hazards & environmental issues related to Packaging and select a specific protection method for the product.
4. Choose various bulk carriers for industrial packaging based on the type of product.
5. Analyse various types of internal fitments for product protection and retainment.
6. Explain the characteristics and applications of various wooden package forms.

Module	Details.	Hrs.
1	Introduction & Classification Introduction to industrial products packaging. Difference between consumer and industrial packaging needs. The packaging Considerations and package design approach, protective requirements and distribution – hazards, their sensitivity influencing packaging design and development criteria. Industrial Products Classification – Product Group Wise, Its Nature, Classification & Requirements; Heavy, Medium and Light Engineering Goods; Electronic Products; Auto Components/ Spares, Chemicals and others.	08
2	Wood as Packaging Material Classification of wood – Groups, softwood & hardwood, plywood Properties of wood – Density, Moisture Content Defects found in wood – Knots, Cross Grain, Cupping, checking and others. Introduction to Wood seasoning & Preservation	08
3	Module - 3: Wood Packaging Forms Wooden Boxes & Crates – Difference & Types, Introduction to Wooden Pallets, Palletized Boxes & Box Pallets and their various components; Wooden Dunnages	06

4	Product Protection Corrosion – Types and Preventive Methods, Introduction to Desiccants Cushioning – Concept, Fragility & Cushion Factor, Shock & Vibration. Open & Closed cell cushions and various cushioning Materials. Internal Fitments – Functions & Different Materials; Types of Internal Fitments - Corner supports, Pads, Liners/collars, Trays, Slotted Partitions and others. Concept of Reinforcement & Unitization	09
5	Bulk Carriers Intermediate Bulk Containers (IBC) – Rigid & Flexible – Types, Materials of Constructions & Various designs. Corrugated Fibreboard Boxes, Paper Sacks, Jerry Cans, Fibre Drums and others.	05

References:

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

Course Code	Course Name	Credits
PPL 501	Plastic Processing and Conversion Technologies Laboratory	1.5

Objectives:

1. To study different plastic processing and conversion techniques
2. To know suitable processing technique as per the end product
3. To study Polymer & Plastic properties influencing conversion techniques
4. To get acquainted with various plastics used in day-to-day life
5. To study and analyse different tests for plastic product

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

1. Describe the fundamental concepts in plastic processing and conversion technology.
2. Analyse the various plastic materials and its application.
3. Understand and use suitable conversion technique as per the end product.
4. Produce plastic products by using various conversion techniques.
5. Perform different testing methods for plastic product.
6. Study different processing parameters required in industry.

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	To study injection moulding machine setup	3 Hrs
2	To study blow moulding machine setup	3 Hrs
3	To manufacture injection moulded article	3 Hrs
4	To manufacture blow moulded article	3 Hrs
5	To study extrusion and blown film machine setup	3 Hrs
6	To make extrusion profile	3 Hrs
7	To manufacture blown film	3 Hrs
8	To determine compression strength of plastic article	3 Hrs
9	To determine flexural strength of plastic article	3 Hrs
10	To Study of Melt Flow Index tester	3 Hrs
11	To Study of environmental stress crack resistance of plastic items	3 Hrs

b) Assignments: Minimum two assignments

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

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

Course Code	Course Name	Credits
PPL502	Package Design and Graphics – I	1.5

Objectives:

1. Study the various product design principles and practically apply them.
2. Learn and understand the tools of SolidWorks Software.
3. Study the method of designing various shapes and 3D objects as per specifications

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

1. Define basic design terminology,
2. Visualize and prepare detail drawing of a given object
3. Create a design based on specific requirement.
4. Design Plastic/Glass/Metal Containers.
5. Analyse various package designs.
6. Design & draw detail and assembly of different packages

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight) (Software to be used: SolidWorks)

Module	Details	Laboratory Sessions
1	Create 2D drawings using different basic entities	3 Hrs.
2	Create basic 3D Models in SolidWorks	3 Hrs.
3	Create 3D Models from 2D Drawings	3 Hrs.
4	Create different parts and learn assembly mating options	3 Hrs.
5	Create an assembly from a given product 2D Drawing	3 Hrs.
6	Create a detailed 2D drawing of an assembly	
7	Create a package from 2D drawing given	3 Hrs.
8	Create a 3D Package Model and draw detailed 2D drawing.	3 Hrs.
9	Create primary package and orient inside a secondary package	3 Hrs.
10	Design a 3D part for prototyping using 3D Printer.	3 Hrs.

b) Assignments: Minimum two assignments to be given.

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

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

Course Code	Course Name	Credits
PPL503	Theory of Machines and Design Laboratory	1

Objectives:

1. Develop an ability to understand the working of mechanisms in machine.
2. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints for various mechanical components.
3. Develop an ability to identify and solve mechanisms in machine.

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

1. Analyse the stresses and strains in mechanical components, and understand, identify and quantify failure modes for mechanical parts.
2. Describe the basic machine elements used in machine design.
3. Design machine elements to withstand the loads and deformations for a given application, while considering additional specifications.
4. Develop the approach to design the component under realistic conditions.
5. Design Machine element against static loading
6. Develop the ability to design the component under realistic conditions

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1.	Study of stress strain diagram and modes of failure	2 Hrs
2	Study of motion characteristics and mechanisms	2 Hrs
3	Construction of velocity and acceleration diagram using instantaneous centre method	2 Hrs
4	Construction of CAM profiles	2 Hrs
5	Design and drawing sheets of Cotter joint	2 Hrs
6	Design and drawing sheets of Knuckle joint	2 Hrs
7	Design and drawing sheets of Flange coupling	2 Hrs
8	Study of welded joints	2 Hrs
9	Study of Torsional Vibrations	2 Hrs
10	Study of Gyroscope	2 Hrs

b) Assignments: Minimum two assignments to be given.

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

Course Code	Course Name	Credits
PPL504	Instrumentation and Process Control Laboratory	1

Objectives:

1. To generate clear understanding of fundamentals of basic measuring devices.
2. To provide details of data gathering, processing and computing.
3. To make students familiar with the various methods of process control

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

1. Knowledge of measuring devices and signal conditioning will help students to select the correct transducer as per the requirement.
2. Students will be able to confidently design a PID controller using opamps or through MATLAB program.
3. The understanding of applications of PLC's in latest printing machines and also packaging machines will be developed.
4. Understand applications of PLC's in industries and printing and packaging machines.
5. Explain PLC and SCADA systems and their use in process control.
6. To Understand and formulate various applications like DAS and data logger

Term Work: (Comprises both a & b)

a) List of Experiments (Minimum Eight)

Module	Details	Laboratory Sessions
1	Study of Displacement measurement using LVDT	2 Hrs
2	Study of Flow measurement by using Rotameter	2 Hrs
3	Study of LDR	2 Hrs
4	Design of Passive Low Pass Filter	2 Hrs
5	Design of Passive High Pass Filter	2 Hrs
6	Design of Active Low Pass Filter	2 Hrs
7	Design of Active High Pass Filter	2 Hrs
8	MATLAB program for study of step response characteristics	2 Hrs
9	MATLAB Program for designing PID Controller	2 Hrs

b) Assignments: Minimum two assignments to be given.

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

Course Code	Course Name	Credits
PPL505	Business & Corporate Ethics	2

Objectives:

1. To inculcate professional and ethical attitude at the workplace.
2. To enhance effective communication and interpersonal skills.
3. To build multidisciplinary approach towards all life tasks.
4. To hone analytical and logical skills for problem-solving

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

1. Communicate effectively in both oral and written form and equip to demonstrate knowledge of professional and ethical responsibilities
2. Design a technical document using precise language, suitable vocabulary and apt style
3. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships
4. Demonstrate awareness of contemporary issues knowledge of professional and ethical Responsibilities
5. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP
6. Deliver formal presentations effectively implementing the verbal and non-verbal skills

Module	Details	Hrs
1	Report Writing Objectives of Report Writing Language and Style in a report Types : Informative and Interpretative (Analytical, Survey and Feasibility) and Formats of reports (Memo, Letter, Short and Long Report)	6 Hrs
2	Technical Writing Technical Paper Writing (IEEE Format) Proposal Writing	4 Hrs
3	Introduction to Interpersonal Skills Emotional Intelligence, Leadership and Motivation, Team Building, Assertiveness, Conflict Resolution and Negotiation Skills, Time Management, Decision Making	8 Hrs
4	Meetings and Documentation Strategies for conducting effective meetings Notice, Agenda and Minutes of a meeting Business meeting etiquettes	4 Hrs
5	Introduction to Corporate Ethics Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.) Introduction to Intellectual Property Rights Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	4 Hrs
6	Employment Skills Group Discussion Resume Writing	10 Hrs

	Interview Skills Presentation Skills Statement of Purpose	
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Assessment:

List of Assignments

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

Term Work

Term work shall consist of all assignments from the list.

The distribution of marks for term work shall be as follows:

Book Report:	10 marks
Assignments:	10 marks
Project Report Presentation:	15 marks
Group Discussion:	10 marks
Attendance:	05 marks

References:

1. Fred Luthans, "Organizational Behavior", Mc Graw Hill,
2. Lesiker and Petit, "Report Writing for Business", Mc Graw Hill
3. R.Subramaniam, "Professional Ethics" Oxford University Press
4. Huckin and Olsen, "Technical Writing and Professional Communication", McGraw
5. Raman and Sharma, Fundamentals of Technical Communication, Oxford University Press
6. Hill Wallace and Masters, "Personal Development for Life and Work", Thomson Learning, 12th Edition
7. Heta Murphy, "*Effective Business Communication*", Mc Graw Hill, edition
8. R.C Sharma and Krishna Mohan, "*Business Correspondence and Report Writing*",
9. Raman Sharma, *Communication Skills*, Oxford University Press
10. B N Ghosh, "*Managing Soft Skills for Personality Development*", Tata McGraw Hill
- Lehman,
11. Dufrene, Sinha, "*BCOM*", Cengage Learning, 2nd edition
12. Bell . Smith, "Management Communication" Wiley India Edition, 3rd edition.
13. Dr. K. Alex , "Soft Skills", S Chand and Company
14. Robbins Stephens P., "Organizational Behavior", Pearson Education
15. <https://grad.ucla.edu/asis/agep/advsopestem.pdf>

Course Code	Course / Subject Name	Credits
PPC601	Packaging Machineries and Systems	3

Objectives:

1. Understand the concept of systems & online Packaging techniques.
2. Understand the various machineries used for conversions of different packaging materials.
3. Study the different packaging machineries used for line operations and systems.
4. Study various ancillary equipment used apart from packaging machineries.
5. Understand the importance of testing, online & offline equipment's used industries

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

1. Suggest the packaging material use and its conversion as per the product geometry.
2. Suggest the filling machine required for the line operations.
3. Choose the ancillary machineries required in the line operations based on the product to be packed.
4. Analyse the different conveying system used for various line operations.
5. Select different online and offline testing methods that are required during the converting operations or on the packaging lines.
6. Suggest Methods and Machine used for case packing.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction and Manufacturing Metals Cans & Drums Introduction, Machineries used for conversion, online packaging, system packaging, Ancillaries Machines and equipment, Online and Offline inspection equipment. Metal Cans-Three piece, DRD & DWI can manufacturing machine and its various sections-Coating Equipments. Metal drum-Types-Different machines used in manufacturing. Fibre & Composite drum- Drum types-Machine used in manufacturing.	06
2.	Module -2: Machineries for Manufacturing of Sacks, Cartoning, Flexible Laminates & Corrugated Box Sacks-Types-Machine used in manufacturing of bag-Synthetic sack-Types-Manufacturing machine. Folding Cartons -Cartoning-Types of Cartons-Machine used in cartoning. Flexible Laminates-Types of lamination techniques-Different components of the Lamination Machine. Corrugated Box-Board construction-Machine used in manufacturing.	05
3.	Module - 3: Types of fillers, VFFS, HFFS, Multiwall Sack filling Filling machineries by count-Filling machineries-Liquid-Carbonated, Still-Design consideration and selection of fillers. Types of Solid fillers-Cup, Weight, Auger, Multi-head weigher Vertical Form fill seal (VFFS), Horizontal Form fill seal (HFFS) Machines-Machine overview, Types-Different section on the machine-New technologies available. Multiwall bag-Types of filling technique.	05

4.	Module - 4: Aseptic System, Retort System Packaging of Drugs & Pharmaceuticals Retort System-Overview-Process description, Canning Operation-Type of Retort system& machines/equipments. Aseptic System-Concept- Types of Aseptic Packs-Aseptic Packaging Machineries based on sterilization method.	06
5.	Module - 5: Blister & Strip Packaging, Case packing Machines, Blister Packaging-Blister Design Parameters-Types of Blisters, Sections on Blister packaging machines. Strip Packaging-Strip packaging process-Materials used-Strip Packing Machinery Case packing or Case loading- Case loading Methods-Machine used in case packing.	04
6.	Module - 6: Wrapping Machines, Ancillary Machines & Equipments Wrapping Machine-Style of wrapping-Machines used Shrink Wrapping Machine-Machine types and its parameters Stretch Wrapping Machine-Pre-stretching film-Types of Wrapper models. Label Applicator Machines-Capping Machines-Sealing machines-Coding & Marking machines-Stencilling-Taping machine-Strapping machine-Slitting machine.	06
7.	Module – 7: Conveying, Buffering &Accumulating Systems and Online &Offline Testing machines Introduction-Integration of Conveyor-Design and Installation of Conveyor systems-Conveying systems-Power transmission components-Transfer between conveyors-Interconnecting machinery Online Inspection machine used on packaging lines. Offline Testing machine-Packaging Materials, Shipping Packages	04

Texts / References:

1. Davis, C.G., Introduction to Packaging Machinery, Packaging Machinery Manufacturers Institute.
2. Luciano, R., How to Write Packaging Machinery Specifications, Institute of Packaging Professionals
3. Zepf, P.J., Improving Packaging Line Performance, Institute of Packaging Professionals
4. G. K. Dubey, Fundamentals of Electric Drives, Narosa Publishing house
5. Dr. J. S. Rao and Dukhipeti, Theory of M/cs and Mechanisms, New Age International
6. H. P. Garg, Industrial Maintenance, S.Chand
7. Kit L Yam, The Wiley Encyclopedia of Packaging Technology, John Wiley & Sons Inc. Publication, 2009
8. F A Paine, The Packaging User's Handbook, Blackie Academic & Professional, 4th Reprint, 1996
9. Kaushik, Chaurasia&Dhakar, "Textbook of Pharmaceutical Packaging Technology", CBS Publishers & Distributors Pvt. Ltd, 1st Edition, 2009
10. EIRI Board of Consultant & Engineer, "Handbook of Packaging Technology", Engineers India Research

Course Code	Course Name	Credits
PPC602	Food and Pharmaceutical Packaging	4

Objectives:

1. Learn and understand the types of food, their modes of deterioration and the fundamentals of package barriers.
2. Learn shelf life studies and sensory evaluation based on type of product.
3. Study the various food preservation techniques with real-life packaging examples.
4. Study the fundamental characteristics of pharmaceutical drugs & their dosage forms.
5. Understand the various existing pharma package forms

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

1. Analyse and choose a barrier material for a specific food product based on barrier properties studied.
2. Analyse and choose a preservation method for a specific food product-based product sensitivity and shelf life required.
3. Describe the various characteristics of pharmaceutical drugs and their sensitivities.
4. Select the right type of package form for a pharma product, based on the product nature, form & size.
5. Determine the shelf life of given food and develop the technique to improve the same.
6. Develop a pharmaceutical package to increase the stability of the medicine during its storage.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Food Packaging An overview & Introduction to the science, technology, socio economic needs and packaging functions. Types of food – Perishable / Semi-perishable, acidity of food product. Gas and Vapour permeation - Basic concepts and theory of permeation and units. Barrier materials used in Food Packaging - Food-package compatibility and migration issues.	10
2.	Module -2: Shelf Life studies and sensory evaluation The concept and factors influencing or affecting shelf life - Food deterioration (Order of reactions) and intrinsic & extrinsic factors, evaluation studies and methods to assess shelf-life (Normal & Accelerated). Sensory evaluation – Concept, Human sensory perception, Errors in sensory evaluation. Sensory Evaluation Tests – Discriminative, Descriptive & Affective/Consumer Tests.	10
3.	Module - 3: Food Preservation Techniques Drying – Cold Preservation (Refrigeration, Deep Freezing) – Pickling – Sterilization (Retort/Canning, Irradiation) Modified & Controlled Atmosphere Packaging – Gases used – Vacuum Packaging Active Food Ingredients.	06

4.	Module - 4: Food products, characteristics and processing needs Cereals and bakery products - Meat and meat products - Dairy and confectionary products, fats, oils, drinks – Fresh fruits & vegetables - frozen foods	04
5.	Module - 5: Characteristics of Drugs & Pharmaceuticals Pharmaceutical vs Food Product – Definition of Drug – Characteristics – Stability – Chemical change/Reactions – Thermal Protection – Light protection – Purity & Sterility. Dosage forms of drugs – Vaccines – Biologically-produced Pharmaceuticals – Medical/Health/Nutritional foods – Packaging materials.	10
6.	Module - 6: Packaging of Drugs & Pharmaceuticals Aseptic Packaging – Types & systems – Injectables and orals/ointments – Ampules, Vials, strip / blister packaging. Packaging of bulk drugs. Reference to IP/BP and significance –packaging regulations – labelling requirements	08

Texts / References:

1. Mathlouthi M., Food packaging & preservation, Blackie Academic & Professional
2. Gordon L Robertson, Food packaging principles & practice, Taylor & Francis Group
3. Food packaging technology Handbook, National Institute of Industrial Research (NIIR) Board
4. Hirsch A., Flexible food packaging, Van Nostrand Reinhold Co.
5. Lee, Yam, Piergiovanni, Food Packaging Science & Technology, CRC Press.
6. Piringer&Baner, Plastic Packaging Materials for Food, Wiley – VCH verlag GmbH.
7. Bauer E., Pharmaceutical Packaging Handbook, 1st Edition, CRC Press
8. Dean D. A., Evans E. R., Hall I. H., Pharmaceutical Packaging Technology, Taylor & Francis
9. Paine F. A., Lockhart H., Packaging of Pharmaceuticals and Healthcare Products, Springer

Course Code	Course Name	Credits
PPC603	Flexographic Printing	4

Objectives:

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

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

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

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Flexography Overview of major conventional printing technologies, the flexographic potential, brief history of process. Working principle, features, characteristics and advantages of flexography. Comparison with other major printing process basic elements of flexography.	04
2.	Module - 2: Image Carrier Design considerations and objectives of general flexographic printing image carrier. Introduction of flexographic plates, Moulded Plate making, Photopolymer plates: sheet and liquid plate making, Laser Design Rolls and Flexo CTP. Properties, Benefits, Comparisons, Handling and Storage of Flexographic Plates. Different light sensitive chemistries used in plate material manufacturing. Kodak Flexcel NX (film-based) versus Esko HD Flexo (laser-based)	08
3.	Module - 3: Mounting & Proofing Need and significance of plate mounting operation. Introduction to mounting. Types of mounting procedures: Double-sided Tape, Magnetic, Sleeve, pin register system. Plate mounting and proofing machines. Troubles and trouble-shooting with regard to improper plate mounting.	04
4.	Module - 4: Flexographic Press Press types: Working, advantages & Limitations of Stack, Common Impression, Inline. Basics of Tension zones and web tension control systems. Printing Station: Types of Inking systems, Fountain Roller, Anilox Roller, Plate Cylinder, Impression Rollers, Dryers and Cooling Rollers, side and circumferential register control. Web Tensions: Tension Zones & Tension ranges, Transducer feedback control, Unwind tension control, In-feed Tension Control, Rewind Tension Control. Web Inspection: Stroboscope, Mirror Drum, TV Print Scanner, Static Control, Film Treaters.	12

5.	Module - 5: Substrates and Inks Absorbent and Non-absorbent substrates, physical properties, printing characteristics, Special substrate. Substrate's surface and optical properties affecting printing resolution. Inks End-use requirements, introduction to printing inks, ink vehicles, ink classifications, principles of ink selection, ink consumption, ink quality assurance tests and ink storage. Ink's surface and optical properties affecting printing resolution.	06
6.	Module - 6: Process Colour Printing Halftone Printing, Theory of colour, colour separations, basic requirements for process colour printing, flexographic printing characterization, ink density and standardization, dot gain. Effects of plate, anilox roller (How to select an anilox for a job), fountain and impression roller on printing density. Process controls & standardization. Process colour screen angles, relationship between LPI requirement and line frequency of anilox roll, electronic colour registration systems. Quality range with FM and AM screening techniques. Extended Colour Gamut printing (fixed-pallet, CMYK OGV)	09
7.	Module - 7: Finishing, Quality Control and Environment & Safety Finishing in flexo (inline and offline), The debate of flexo versus gravure, Introduction & Characteristics of quality, economics of quality improvement, the principles of total quality management, statistical process control, tools of statistical process control, element of process control in flexography. ISO 9000. Environment & Safety Clean Air Act, Food safety concerns (role of flexo inks), Toxic substance control act, Resource conservation & recovery act, occupational safety & health act.	05

Texts / References:

1. Foundations of FTA, Flexography Principles & Practices, 5th Edition.
2. Herbert L. Weiss, Flexography Proficiency, Converting Technology Corp.
3. Tony White, High Quality Flexography, Pira International Reviews.
4. J. Michael Adams, Printing Technology, 5th Edition, Delmar.
5. Michael Barnard "The Print & Production Manual" PIRA.

Course Code	Course / Subject Name	Credits
PPC604	Colour Management	3

Objectives:

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

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

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

Sr. No.	Details	Hrs
1.	Module - 1: Need for Colour Management Need for colour management, device characteristics, closed and open loop colour control, Steps in CMS - calibration, characterization, conversion; International colour consortium – standards, profiles, profile types, profile structure, Colour measurement, viewing conditions.	06
2.	Module - 2: Profiles Test targets, Devices, Calibration and characterization of scanner-Different test charts available for scanner, digital camera-DC Profile maker-Profile settings, monitor- 4Cs, Monitor viewing settings, Press and Proofer- IT test charts, Issues, Profiling software- Settings	07
3.	Module - 3: Conversion CMM-Colour Management Module in various display devices, Gamut boundaries, Different types of Rendering Intent- Absolute, Relative, Colorimetric, Saturation- Gamut mapping – influencing factors, algorithms- Parametric Gamut mapping algorithm, Successive mapping algorithm.	07
4.	Module - 4: Colour Management Workflow Colour Management workflows – RGB workflow, CMYK workflow, embedded workflow, assumed workflow, Internet workflow, Soft proofing, Hardcopy proofing, Colour management in software applications (Adobe Photoshop), Operating System (Microsoft, Apple)	07
5.	Module - 5: Current Trends in Colour Management & Introduction to Digital Printing: Dynamic Device link profiles, Profile editing, profile quality, ECI, Colour appearance modelling, Case studies. Quality Control in Profiles. Digital Technology types: Primarily electrophotography, inkjet (wide-format versus sheetfed inkjet), HP Indigo, Webfed digital for labels and packaging applications, Costing for digital printing, Digital Finishing/Post-press, IT expertise for data handling for VDP, Substrates suitable for digital printing	09

Texts / References:

- 1) Abhay Sharma, Understanding Colour Management
- 2) Richard M. Adams, Joshua B. Weisberg GATF press, The GATF practical guide To Colour Management
- 3) R.W.G Hunt, The Reproduction of Colour, Fountain Press, England
- 4) E.P. Danger, The Colour Handbook, Gower Publication

Course Code	Course Name	Credits
PPDE6011	Packaging Distribution Dynamics (Department Elective –I)	4

Objectives:

1. Learn the fundamentals hazards encountered in distribution
2. Study the various principles of distribution dynamics.
3. Learn the method for estimating the vibration, shock encountered by a product in distribution
4. Study estimation of cushioning requirement for a product in distribution.
3. Understand the different tests that can be done to gauge package performance in distribution.

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

1. Analyse the hazards encountered in distribution and determine protection requirement
2. On the basis of principles of distribution dynamics estimate the vibration, shock encountered by a product in distribution
3. Calculate cushioning requirement for a product in distribution.
4. Perform tests to gauge package performance in distribution.
5. Analyse ways to reduce the effect of vibration, shock and handling of product during distribution.
6. Explain the method for developing the cushion curve and damage boundary curve.

Sr. No.	Details	Hrs
1.	Module - 1: Introduction: Overview of Packaging distribution - Modes of distributions – Hazards in Distribution – Vibration, Impact, Drop, Compression, Shock	03
2.	Module - 2: Fundamentals of Motion & Vibration Mass – Velocity – Acceleration Introduction to Vibration – Simple vibratory motion – The yo-yo analogy – Linear Spring – Natural frequency – Vibrating Spring mass system – Combination of springs and cushions – Spring Constant & Modulus of elasticity. Concept of Unforced & Forced Vibration - Vibration Magnification – Sample problems	10
3.	Module - 3: Damped Vibrations, Vibrations in Distribution, Testing & Random Vibration Damped Vibration – Vibration sensitivity – Vibration of packaged product - Random Vibration – Fourier analysis - Power Density Spectrum – Vibration Test Equipments- Sample problems	13
4.	Module - 4: Mechanical Shock, shock in distribution and Cushion design Introduction - Free Falling Package - Mechanical Shock Theory - Shock Duration - Shock Amplification & Critical element –Horizontal Impacts - Mechanical Shock in Distribution System - Damage Boundary Curve (DBC) – Constructing a DBC - Shock Fragility - Shock Response Spectrum Cushion Design & product protection – Cushions & Vibrations - Sample problems	14

5.	Module - 5: General Considerations for Package Testing Introduction to Distribution Testing/Transport or Distribution Engineering – Hazards of the Logistical Environment - Measuring Logistical Hazards – Product Design for Distribution - Package Performance Testing - Equipments - National & International Testing Protocols - Reference to ASTM / IS standards – Distribution tests in detail – Drop, Compression, Impact, Vibration, Shock, Rolling, Salt Spray, Rain and other tests.	08
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Texts / References:

1. Brandenburg & Lee, Fundamentals of Packaging Dynamics
2. Harris & Crede, Shock & Vibration Handbook. McGraw Hill
3. Goodwin & Young, Protective Packaging for Distribution, Destech Publications

Course Code	Course Name	Credits
PPDE6012	Inks and Coatings (Department Elective –I)	4

Objectives:

1. To study the ink formulation and its components.
2. To study the requirements of inks for different printing processes and materials.
3. To understand the working of different coatings.

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

- 1.Explain the formulation for different types of inks
- 2.Explain the ink components for different printing processes and materials
- 3.Test and analyse the properties of inks and coatings.
- 4.Suggest ink for a given process
- 5.Troubleshoot problems related to ink synthesis
- 6.Suggest suitable varnish for a given application.

Sr. No.	Details	Hrs
1.	Module - 1: Raw Materials Introduction & History of inks - Applications of ink - Ingredients and their functions- Pigments and dyes in printing Inks - organic and inorganic – pigments for different colours and effects - their sources and processing. Vehicle components - oil, resin, solvent, additives – Oils – drying and non-drying – oils for odours – Solvents – diluents/drying/dissolving, distillate and volatile. Resins – their functions- natural and synthetic – Additives – driers, anti-oxidants, plasticizers, anti-setoff, anti-foaming, anti-settling, anti-pinhole and anti-misting agents, surfactants, gelling agent.	14
2.	Module - 2: Types of Inks Printing Inks for different processes - letterpress, lithography, dry offset, gravure, flexographic, inkjet and screen inks - formulation, components and functions - troubleshooting for ink related problems Inks as per different drying process- cold-set, heat-set, quickset, UV curable – the formulation and working. Inks for different substrates – absorbent, non-absorbent- coated paper, newsprint, tinplate, flexible packaging, Processing of substrate for ink adhesion.	14
3.	Module - 3: 3.1 Manufacturing Process Making of varnish – Paste ink and liquid ink - Mills for mixing the components- Roll mill – two, three and four roll - Ball and bead mill - Mixers- Rotor/stator, cavitation. Storage and Handling – liquid & paste inks – Ink Packaging – Health, Safety and Environment- Estimation of ink requirements and ordering. 3.2 Properties and Testing Optical properties- colour, transparency, tint, gloss. Flow properties- rheology- Newtonian/non-newtonian, viscosity, tack. Resistance properties- light, acid and alkali, heat, abrasion.	14

4.	Module - 4: Other coatings in printing and packaging Varnish- functions, formulation and manufacturing – overprint and spot varnish coating methods, Priming coats, lacquers for metals – formulations and coating methods, Other functional coatings- corrosion resistant, water resistant and chemical resistant, silicone release, biocides, self-seal adhesives.	06
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Texts / References:

1. R.H.Leach & R.J.Pierce, The Printing Ink Manual, 5th ed., Kluwer, 1991
2. Arthur Tracton ,Coatings Materials and surface Coatings, 3rd ed., CRC Press, 2007
3. NIIR, Modern Technology of Printing & Writing Inks, 1st ed., Asia Pacific Business Press
4. NPCS, “Inks, Paints, Lacquers, Varnishes and Enamels”, NPCS

Course Code	Course Name	Credits
PPDE6013	Digital and security Printing (Department Elective –I)	4

Objectives:

1. To study digital printing & the importance of security printing with respect to bank note papers and boards, passports and government documents.
2. To study image editing
3. To understand limitations, pros & cons of digital printing.
4. To study working principles and applications of different digital printing devices
5. To study first line inspection of different documents

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

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

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Digital Printing Understanding the digital printing, when to go for digital? Creating and processing the image: anatomy of digital image, pixel and bit depth, resolution, halftones, contones and dither. Digital image input, image editing using software. File format and image compression. Printer drivers and printing software. Comparing digital printing technologies with conventional. Storage devices. Limitations, Pros & cons of digital printing.	08
2.	Module - 2: Digital Print Technologies Introduction to digital presses. Digital Workflow: Introduction to workflow, comparison between conventional & digital workflow. Elements of workflow, job ticket, pre-flight checking, trapping, proofing, imposition, archiving, corrections, conversion, image replacement, APR, OPI servers, networking. Operation, construction, working principles and applications of different digital printing devices - Inkjet, Electrophotography, Ionography, Magnetography, Thermography, Electrography. High volume – Xeikon and Indigo E-print. Direct imaged conventional press. Latest development in digital printing.	10
3.	Module - 3: Digital Print Application (Digital proof & Inkjet proof, requirements of a proofing system, and latest trend in proofing technologies. Customize printing, print on demand, variable data printing, distribute & print, remote publishing, wide format printing, 3D, printing on microscopic items.	10

4.	Module - 4: Introduction to Security Printing Introduction to security Printing, Optical document security, importance of security printing of bank note papers and boards, passports and government documents. UV-visible Printing, rainbow printing, micro lines, guilloches, numbering, Line-printing, stamp embossing, hot-foil-embossing, embossing / punching, fibers, hologram, solvent colour, multi-colour UV-fluorescence stitching thread, holographic foil or lamination of a page, Digital Watermark.	06
5.	Module - 5: Inks and Brand Security Inks: Invisible inks, Specialist security printers inks; such as thermos-chromic, UV fluorescing, water fugitive, solvent sensitive inks, combifuge, photo chromic, Fluorescent Inks, Watermarks, Testing, Deterrent measures Brand Security: First line inspection of documents using optical elements such as Holograms, optical variable graphics, diffraction structures, liquid crystal materials, optical security in laminates etc., invisible document security and Brand protection.	06
6.	Module - 6: Security Products Credit Cards, Smart cards, club cards, credit / debit cards, Plastic ID cards, Water mark cards, RFID technology, Bar codes, Printers used for bar codes, Cheques and their value documents, MICR/OCR/Cheque printing technology Counterfeit, fraud prevention, Cheque fraud prevention, method and arrangement for processing negotiable instruments. First line inspection of documents using optical elements such as Holograms, optical variable graphics, diffraction structures, liquid crystal materials, optical security in laminates etc. invisible document security and Brand protection.	08

Texts / References:

1. "Computer Stationery and MICR Cheque Production" Association for research and development in printing, Madras
2. "Hand Book of Printing Technology" EIRI Board of Consultants and Engineers, Engineers India Research Institute, New Delhi
3. "Bank Credit Card Business" Indian Institute of Bankers (1999), Macmillan, Delhi
4. "Introduction to security printing" Richard D. Warner and Richard M. Adams II, PIA GATF Press
5. "Handbook of Print Media", H Kipphan, Springer – VerlagBzlin Heidelberg, 2001
6. "The Hand Book of Digital Publishing (Volume I) PH" Michel L. Kleper, PTR Publishing
7. "Art and Print Production", N.N Sarkar, Oxford Publication Harald Johnson, Mastering Digital Printing
8. "Inkjet printing tips and techniques" Andrew Darlow

Course Code	Course Name	Credits
PPDE6014	Print Finishing and Converting (Department Elective –I)	4

Objectives:

1. Introducing the basic concepts of print finishing and binding.
2. Study Raw materials and consumable for finishing and binding operations.
3. Study Machineries and equipment required in different finishing and binding operations.

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

1. Analyse the print finished product.
2. Examine the Product for the entire process involved in manufacturing and finishing.
3. Discuss the print finishing requirements for verity of different segment jobs.
4. Analyse the layout and imposition of the job
5. Identify and rectify post finishing process problems
6. Discuss the various post finishing terminology

Sr. No.	Details	Hrs
1.	Module - 1: Introduction to Binding & Finishing Overview of Binding & finishing and its scope, Physical Parts of Book, Binding classifications. Major operation performed in binding and finishing. Pre-forwarding, forwarding operations. Tools and equipments used for binding, Binder's marks. Organization and bindery layout. Latest developments in print finishing.	06
2.	Module - 2: Materials Paper- British standard and ISO paper sizes. Advantages of ISO paper sizes. Advantages and Limitations of different measurement, standards Units for number of paper ream, quire, gross. Types of boards. Multiples and subdivisions of a given size. Study of different types applications of board used in binding and finishing work. Securing materials- Thread, wire, tape, cord - Selection based on application, gauge of wire, thread strength, and cost. Covering materials- Binding cloth, Mull cloth, Rexene, leather, laminates, jackets. Adhesives –Adhesion theory for binding, types of adhesives and their properties and applications, various selection criteria for adhesives.	12
3.	Module - 3: Pre-forwarding and forwarding operation Pre-forwarding Operation -Jogging & knocking, removing Mis-registered sheets, counting, folding, bundling, gathering, collating, and sewing. Forwarding operations - Removing the swell, fixing end papers, fraying out the slips, gluing the back, trimming, rounding and backing, fixing head & tail bands, lining the back, edge decoration, cutting the boards, capping up, squaring the board, lacing in, covering, setting the joints, pasting down, pressing, jacketing.	12

4.	Module - 4: Folding and Cutting Machines Knife folding, buckle folding, combination folding principle, construction and working Hand folding- method of various folding scheme, advantages and limitation Gathering machines-construction and working Machines: Single knife guillotine machine-major parts and their function, maintenance, safety devices, trim disposal system, application. Straw board cutter- construction and working. Three knife trimmer-major parts, function and its application.	06
5.	Module - 5: Securing methods and Binding Machines Study of construction and working principle of wire stitching machine, Thread securing method. Study of construction and working principle of book sewing machine. Case binding, case making machine- part and functions. Covering- Quarter, half, full, limp & library style binding. Boarding methods- Pasting down, split, draw in work, cut flush, extra square. Stationary Binding. Binding Machines Perfect Binding Machines-Major parts and their functions, maintenance, safety devices, application. Types- Burst binding, Notch binding, two shot wet on wet binding.	08
6.	Module - 6: Finishing and converting Operation Blocking, Numbering, Perforation, Creasing, Die-cutting, round cornering, Edge decoration-gilding, Index cutting, Foil stamping, graining, varnishing, Embossing, eyeletting, ruling and numbering. Spot UV.	04

Texts / References:

1. Lyman Ralph, "Binding and Finishing", GATF, USA
2. Tedesco T.J. (1999) "Binding Finishing Mailing" GATF, USA
3. Mendiratta, "Binding and Finishing", Printek Publication, New Delhi.
4. Geoff & Potter, "Binding and Finishing", Blue Print
5. Hugh Speirs, "Introduction to Printing and Finishing" PIRA, UK (1998)
6. A.G. Martin, "Finishing process in Print Industry", Hastings House, 1972.
7. Aurther W. Johnstori, "The Manual for Book Binding", Thames and Hudson, 1984.
8. U.S. Govt. Printing- Theory and Practice of Book Binding

Course Code	Course Name	Credits
PPT601	Packaging Machineries & Systems Tutorials	2

Objectives:

1. Understand the concept of systems & online Packaging techniques.
2. Understand the various machineries used for conversions of different packaging materials.
3. Study the different packaging machineries used for line operations and systems.
4. Study various ancillary equipment used apart from packaging machineries.
5. Understand the importance of testing, online & offline equipment's used industries

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

1. Suggest the packaging material use and its conversion as per the product geometry.
2. Suggest the filling machine required for the line operations.
3. Choose the ancillary machineries required in the line operations based on the product to be packed.
4. Analyse the different conveying system used for various line operations.
5. Select different online and offline testing methods that are required during the converting operations or on the packaging lines.
6. Suggest Methods and Machine used for case packing.

Term Work: (Comprises both a & b)

a) Minimum Eight tutorials:

During tutorial sessions learners should study the different machine components/elements and study the demonstration of various packaging machines.

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

1. Online & Offline Inspection systems
2. Automatic filling systems
3. Accumulation systems
4. Latest developments in packaging/printing machineries.

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

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

Course Code	Course / Subject Name	Credits
PPL601	Package Design & Graphics-II	2

Objectives:

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

Outcomes:

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

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

Term Work: (Comprises both a & b)

a) List of Practicals / Experiments (Minimum 10)

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

b) Assignments: Minimum two on any of the following topics:

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

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

End Semester Practical Examination (for 50 Marks): Under single head of examination, including Practical (40 marks assessment) followed by oral (10 marks assessment) to be conducted by internal and external examiners.

Course Code	Course / Subject Name	Credits
PPL602	Flexographic Printing Laboratory	1.5

Objectives:

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

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

1. Operate flexography machine.
2. Acquire skills to handle trouble-shooting on flexography presses.

Term Work: (Comprises both a & b)

a) List of Practicals / Experiments (Minimum 8)

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

b) Assignments: Minimum two assignments to be given on the working of flexographic machine covering various process parameters.

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

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

Course Code	Course / Subject Name	Credits
PPL603	Colour Management Laboratory	1

Objectives:

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

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

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

Term Work: (Comprises both a & b)

a) List of Practicals / Experiments (Minimum 10)

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

b) Assignments: Minimum two assignments to be given on different principles of colour management used in the industry.

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

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

Course Code	Course / Subject Name	Credits
PPDET601X	(Department Elective –I Tutorial)	1

PPDET6011 – Packaging Distribution Dynamics

During tutorial sessions learners should understand the various testing methods & equipments used for evaluating transport packages as per IS/ASTM or other standards

PPDET6012 – Inks & Coatings

During tutorial sessions learners should understand the various testing methods & equipments used for evaluating inks & coatings as per IS/ASTM or other standards

PPDET6013 – Digital & Security Printing

During tutorial sessions learners should study & understand different digital images, file compression techniques & their effects on image quality, digital proofing, security printing features in real-life examples and various testing methods used in digital/security printing as per IS/ASTM or other standards

PPDET6014 – Print Finishing & Converting

During tutorial sessions learners should study the various operations involved and material requirement in different procedures of print finishing and converting.

Minimum eight tutorials to be conducted and minimum two assignments to be given under each elective. Assignments may also include objective tests, live case studies, presentation, etc.

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

Course Code	Course Name	Credits
PPS601	Industrial Visits	1.5

Objectives:

1. To give the practical exposure with better Industrial orientation
2. Experience the raw material processing and conversion in print and packaging
3. Study Machineries and processes evolved in different print and packaging industries

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

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

Sr. No.	Type of Industries that can be visited
1.	Paper & paperboard manufacturing/ Paper & paperboard recycling plants
2.	Label stock manufacturing, and Printing
3.	Offset, Flexography, Gravure printing presses
4.	Screen Printing & Pad Printing Presses
5.	Digital Printing, Proofing and Large Format Presses
6.	Newspaper presses
7.	Commercial/ magazine printing presses
8.	Binding and finishing operation houses
9.	Plastics tube manufacturing & printing
10.	Plastics drum / Can manufacturing & printing
11.	Metal can/ tube manufacturing, printing and decoration
12.	Metal drum/tin box manufacturing, printing
13.	Carton box and Corrugated fiberboard box manufacturing
14.	Fiberboard drum/ composite box package manufacturing
15.	Thermoform manufacturing and packages manufacturing
16.	Glass factory and Glass bottles manufacturing
17.	Blow moulding, Injection moulding and Rotational moulding factories
18.	Cushion material manufacturing
19.	Multiwall / woven sack manufacturing
20.	VFFS / HFFS filling machine line for Solid and liquid filling operations
21.	Frozen food packaging facilities/ factory
22.	Pharmaceutical packaging
23.	Bakery product and Confectionary packaging
24.	Milk & milk product packaging unit
25.	Edible oil, Lubricant packaging
26.	Aluminium Collapsible Tube Manufacturing unit
27.	Blown film plant

28.	Mumbai Port Trust, Marine cargo Handling
29.	Aseptic filling, Vacuum and Gas flush Packaging machines
30.	Package Sterilization facilities

At least 8 Industrial Visits to be conducted. Care should be taken, not to visit similar industries more than once, since the concept is to help students practically see & learn as many manufacturing & converting facilities as possible.

Termwork:

During industrial visits, students are expected to study the process, machines, consumables & facilities utilized in the Industry. They have to then write a report for every Industrial visit based on their understanding.

Industrial Visit Reports: 20 Marks

Attendance: 05 Marks

End Semester Oral Examination:

Under single head of examination, oral to be conducted by internal and external examiners for 25 Marks.

1. Question will be compulsory asked, based on visited Industries only.
2. Questions may be randomly asked, based on the industrial visit reports prepared by the students.