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Item No. 4.70

UNIVERSITYOFMUMBAI

Revised Syllabus for the M. E. Program

Program: M. E. (Mechanical)

PRODUCT DESIGN AND DEVELOPMENT

(As per **Choice Based Credit and GradingSystem**
with effect from the academic year 2016–2017)

From Co-ordinator's Desk:-

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated 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 meetings unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs), give freedom to Affiliated Institutes to add few (PEOs), course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth of 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 are 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, **Choice 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. Faculty of Technology has devised a transparent credit assignment policy, adopting a ten point scale to grade learner's performance. Choice Based Credit and Grading System is implemented for Master of Engineering from the academic year 2016-2017.

Dr. S. K. Ukarande
Co-ordinator,
Faculty of Technology,
Member - Academic Council
University of Mumbai, Mumbai

Chairman's Preamble:

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, 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 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 major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives for Postgraduate Program were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the postgraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above, 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of postgraduate program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stake holders.

Dr. S. M. Khot

Chairman, Board of Studies in Mechanical Engineering, University of Mumbai

Program Structure for
ME Mechanical Engineering (Product Design and Development)
Mumbai University
(With Effect from 2016-2017)

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
PDDC101	ProductDesign and Development	04	--	04	--	04
PDDC102	Rapid Prototyping and Tooling	04	--	04	--	04
PDDC103	Material in Product Design and Development	04	--	04	--	04
PDDDLO101X	Department Level Optional Course I	04	--	04	--	04
ILO101X	Institute Level Optional Course I	03	--	03	--	03
PDDL101	Laboratory I - CAD: Solid Modeling Lab	--	02	--	01	01
PDDL102	Laboratory II - Rapid Prototyping and Tooling Lab	--	02	--	01	01
Total		**19**	**04**	**19**	**02**	**21**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End SemExam	Exam Duration (Hrs)			
		Test1	Test 2	Avg					
PDDC101	ProductDesign and Development	20	20	20	80	03	--	--	100
PDDC102	Rapid Prototyping and Tooling	20	20	20	80	03	--	--	100
PDDC103	Material in Product Design and Development	20	20	20	80	03	--	--	100
PDDDLO 101X	Department Level Optional Course I	20	20	20	80	03	--	--	100
ILO101X	Institute Level Optional Course I	20	20	20	80	03	--	--	100
PDDL101	Laboratory I - CAD: Solid Modeling Lab	--	--	--	--	--	25	25	50
PDDL102	Laboratory II - Rapid Prototyping and Tooling Lab	--	--	--	--	--	25	25	50
Total		**100**	**100**	**100**	**400**		**50**	**50**	**600**

Course Code	Department Level Optional Course I	Course Code	Institute Level Optional Course I
PDDDLO1011	Computer Aided Product Development	ILO1011	Product Lifecycle Management
PDDDLO1012	Creativity in Design	ILO1012	Reliability Engineering
PDDDLO1013	Die Design and Development	ILO1013	Management Information System
PDDDLO1014	Product Packaging	ILO1014	Design of Experiments
		ILO1015	Operation Research
		ILO1016	Cyber Security and Laws
		ILO1017	Disaster Management and Mitigation Measures
		ILO1018	Energy Audit and Management

Semester II

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
PDDC201	Quality Concepts in Design	04	--	04	--	04
PDDC202	Design for X	04	--	04	--	04
PDDC203	Applied Ergonomics	04	--	04	--	04
PDDDLO 202X	Department Level Optional Course II	04	--	04	--	04
ILO202X	Institute Level Optional Course II	03	--	03	--	03
PDDL201	Laboratory III - CAD:Surface Modeling Lab	--	02	--	01	01
PDDL202	Laboratory IV - CAE: Computer Aided Engineering	--	02	--	01	01
Total		**19**	**04**	**19**	**02**	**21**

Course Code	Course Name	Examination Scheme							
		Theory							
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)	Term Work	Pract/ Oral	Total
		Test1	Test 2	Avg					
PDDC201	Quality Concepts in Design	20	20	20	80	03	--	--	100
PDDC202	Design for X	20	20	20	80	03	--	--	100
PDDC203	Applied Ergonomics	20	20	20	80	03	--	--	100
PDDDLO 202X	Department Level Optional Course II	20	20	20	80	03	--	--	100
ILO202X	Institute Level Optional Course II	20	20	20	80	03	--	--	100
PDDL201	Laboratory III - CAD:Surface Modeling Lab	--	--	--	--	--	25	25	50
PDDL202	Laboratory IV - CAE: Computer Aided Engineering	--	--	--	--	--	25	25	50
Total			**100**	**100**	**400**		**50**	**50**	**600**

Course Code	Department Level Optional Course II	Course Code	Institute Level Optional Course II
PDDDLO2021	Vehicle Design	ILO2021	Project Management
PDDDLO2022	Polymeric Material and Processing	ILO2022	Finance Management
PDDDLO2023	Reverse Engineering	ILO2023	Entrepreneurship Development and Management
PDDDLO2024	Product Marketing	ILO2024	Human Resource Management
		ILO2025	Professional Ethics and CSR
		ILO2026	Research Methodology
		ILO2027	IPR and Patenting
		ILO2028	Digital Business Management
		ILO2029	Environmental Management

Semester III

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract	Total
PDDS301	Seminar	--	06	--	03	03
PDDD301	Dessertation I	--	24	--	12	12
Total		**--**	**30**	**--**	**15**	**15**

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam			
		Test1	Test 2	Avg				
PDDS301	Seminar*	--	--	--	--	50	50	100
PDDD301	Dessertation I	--	--	--	--	100	--	100
Total			**--**	**--**	**--**	**150**	**50**	**200**

Semester IV

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract	Theory	Pract /Oral	Total
PDDD401	Dessertation II	--	30	--	15	15
Total		**--**	**30**	**--**	**15**	**15**

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract/Oral	Total
		Internal Assessment			End Sem Exam			
		Test1	Test2	Avg				
PDDD401	DessertationII*	--	--	--	--	100	100	200
Total		**--**	**--**	**--**	**--**	**100**	**100**	**200**

***Seminar of Semester III and Dissertation II of Semester IV should be assessed jointly by the pair of Internal and External Examiners**

Note- The Contact Hours for the calculation of load of teacher are as follows
Seminar - 01 Hour / week / student
Project I and II - 02 Hour / week / student

Course Code	Course Name	Credits
PDDC 101	**Product Design and Development**	**04**

Objectives

1. To study the basic concepts of product design and development process.
2. To study the applicability of product design and development in industrial applications
3. To study the key reasons for design or redesign.

Outcomes: Learner will be able to…

1. Select an appropriate product design and development process for a given application
2. Choose an appropriate ergonomy for the product.
3. Select an appropriate standardisation method.
4. Develop the methods to minimise the cost.

Module	Detailed Contents	Hrs.
01	1.1 Introduction:Classification/SpecificationsofProducts. 1.2 Product lifecycle. Productmix. 1.3 Introductionto product design. 1.4 Modernproductdevelopmentprocess. 1.5 Innovative thinking. 1.6 Morphologyof design..	08
02	2.1 ConceptualDesign:Generation,selection& embodimentof concept. 2.2 Productarchitecture. 2.3 Industrialdesign: process, need. 2.4 Robust Design:TaguchiDesigns&DOE. 2.5 DesignOptimization	08
03	3.1 DesignforMfg& Assembly: Methodsof designingforMfg&Assy. 3.2 Designs forMaintainability. 3.3 Designs forEnvironment. 3.4 Productcosting. 3.5 Legalfactorsandsocialissues.Enggethicsandissues ofsocietyrelatedto design of products.	10
04	4.1 ValueEngineering/ Value Analysis. : Definition.Methodology. 4.2 Casestudies. 4.3 Economicanalysis:Qualitative &Quantitative.	08
05	5.1 Ergonomics/ Aesthetics:Grosshumanautonomy. 5.2 Anthropometry. 5.3 Man-Machine interaction. 5.4 Conceptsofsize andtexture,colour.Comfortcriteria. 5.5 Psychological&Physiological considerations. 5.6 CreativityTechniques:Creativethinking,conceptualization,brainstorming,primarydesign,drawing, simulation, detaildesign.	10
06	6.1 ConcurrentEngg, 6.2 Rapidprototyping, 6.3 Tools for productdesign– Drafting/ Modelingsoftware. 6.4 CAMInterface. 6.5 Patents&IPActs.Overview,Disclosure preparation.	08

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGrawhill New Delhi 2003
2. David G Ullman, "The Mechanical Design Process." McGrawhill Inc Singapore 1992 N J M Roozenberg , J Ekels , N F M Roozenberg " Product Design Fundamentals and Methods ." John Willey & Sons 1995
3. Kevin Otto & Kristin Wood Product Design: "Techniques in Reverse Engineering and new Product Development." 1 / e 2004 , Pearson Education New Delhi
4. L D Miles "Value Engineering."
5. Hollins B & Pugh S "Successful Product Design." Butter worths London.
6. Baldwin E N & Neibel B W "Designing for Production." Edwin Homewood Illinois
7. Jones J C "Design Methods." Seeds of Human Futures. John Willey New York.
8. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill NewYork

Course Code	Course Name	Credits
PDDC102	**Rapid Prototyping And Tooling**	**04**

Objectives

1. To Familiarise students with rapid prototyping and tooling technologies.
2. To study basic concepts of reverse engineering and their application in product development.
3. To study advanced manufacturing techniques.

Outcomes: Learner will be able to…

1. Communicate with community and professional environment about RPT
2. Classify and select proper rapid prototyping and reverse engineering techniques for specific technical applications.
3. Use detailed knowledge in the field of selected advanced manufacturing methods. Moreover inspection methods concerning quality of manufactured prototypes are introduced too.
4. Utilize basic reverse engineering technologies, programing and operating sophisticated technical equipment.
5. Think and work in creative and entrepreneur way with giving consideration of economic aspect

Module	Detailed Contents	Hrs.
01	**Rapid Prototyping** • HistoricalDevelopment • Applications:Design, Planning, Manufacturingand Tooling • Applications:Automotive,Jewelry, Coin andBio-Medical • Fundamentals of Rapid Prototyping,DesignProcess • RapidPrototypingProcess Chain	09
02	**Subsystems ofRPMachine** • Subsystems of RP machineo OpticalSystem o Mechanical ScanningSystem o Computer Interfacinghardware,DAQso SignalFlow, 3DModel to RPPrototype • Introduction to 3D ModelingSoftwares (Auto-CAD, PROE, CATIA,IDEAsetc.) • SlicingandScanPathGenerationAlgorithms • DataConversionandTransmission • File Formats,IGES, STL • Preprocessingand Post-processing	10
03	**Liquid Based RapidPrototypingSystems** • Materials • Stereolithography • Solid GroundCuring • Solid Object UV (Ultra-Violet) Printer • TwoLaserSystem • Micro-stereolithography.	10
04	**Solid Based Rapid PrototypingSystems** • Materials • LOM(Laminated Object Manufacturing)System • FDM(FuseDepositionModeling)System • Multi-Jet Modeling(MJM) System • ModelMakerandPatternMaster • Shape Deposition ManufacturingProcess	08

05	**Powder Based Rapid PrototypingSystems** • Materials • SLS(SelectiveLaser Sintering) • (3DP)Three-Dimensional Printing • (LENS)LaserEngineeredNet Shaping • (MJS) MultiphaseJet Solidification • (EBM)ElectronBeam Melting	07
06	**Advances inRPSystems and CaseStudies** • Advances in RP: Resolution&Accuracyissues,IntegratedHardeningProcess, Two Photon Process for Micro/NanoFabrication,ReverseEngineeringProcessandApplications. • Case Study: Wind-Tunnel Testingwith RP Models • Case Study:InvestmentCastingwith RP	08

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W. Liou, Frank W. Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr

Course Code	Course Name	Credits
PDDC103	**Material In Product Design & Development**	**04**

Objectives

1. To expose the students to the material aspects of Product design.
2. To study importance of material in Process modeling and design for assembly
3. To expose the students to new material processing techniques

Outcomes: Learner will be able to…

1. Understand the behavior of various metals and non-metals
2. Learn about the selection of material for different applications
3. Get exposure to the manufacturing processes in micro fabrication

Module	Detailed Contents	Hrs.
01	**Material Behavior And Selection** ElasticandPlasticdeformation-MechanismofPlasticdeformation-yieldstressandshearstrength-PerfectandRealcrystals-Effect ofstrainrateandtemperatureonplasticbehaviour-Superplasticity-Deformation ofnoncrystalline materials- Materialselection-Costandservicerequirement-Recycling-Selectionofmaterialformechanicalproperties-Strength,toughnessandfatigue-MaterialselectionfordurabilityandsurfacewearandCorrosionresistance-Functionalrelationbetweenmaterialsandprocessing-Manufacturingcharacteristicsofmetals-Materialselectionchartsandotheraidsmaterialselectionforaero,autoandnuclearapplication-StructuralProduct analysis-End Usebehavior –Toolinginproduct design- Case studies in materialselection.	08
02	**ProcessModelingAndProduct Design** Methodsofanalysis-Slab,sliplineandupperboundsolutions-Numericalmethods-EffectofFriction-Contactproblem-Basicanalysisofprocess-Forging,Drawingandsheetmetalforming-machining-Turning-modernmaterials-microalloyedanddual phasesteel-Highstrengthlowalloymetals-Smartmaterials-Shapememorymetals-MetallicGlasses-NanoMaterials-Metalfoams-Propertiesandapplications forproductdesign.	08
03	**Non MetalsAndManufacturing** Generalpropertiesand its importance of polymers-Thermalandelectricalpropertiesmechanicalproperties-Criteriaforselection-Compositematerials-fibers-Boron,glass,carbon,organic-Ceramicandmetallicfibres--Matrixmaterials-Polymer,metalandceramics-propertiesandapplications-Manufacturingmethodsofplasticproducts-Injectionandblowmoulding–Rotationalmoulding-Compressionmoulding-Transfermoulding-layeringof composites	10
04	**ProductDesign AndAssembly Requirements** Structuralproductanalysis-Endusebehaviour-Effectoftoolinginproductdesign-Designforjoiningandassembling-Designforlivehinges-Snapfits,designofcorners,bushesandribs-Designconsiderations-Newproductdesign-Methodsofdecoration-Bondingandcementingtechniques-Thermalbonding-Machiningofplastics-Parametersandeffect-Casestudiesinmaterialselectionwith relevance to productdesign and development	08
05	**Development InMaterialsProcessing**	08

	Microfabricationtechnologies-Toolformicrofabrication-Diamondandhighspeedmachining-LIGAmicrofabrication process- MultilayerX-raylithography-	
06	**Introduction toSmart / IntelligentMaterials:** OverviewofSmart/IntelligentMaterials,PrimitiveFunctionsofIntelligentMaterials,IntelligenceInherentinMaterials,ActuatorMaterials,SensingTechnologies,Micro-sensors,IntelligentSystems,HybridSmartMaterials,PassiveSensorySmartStructures, ReactiveActuatorbasedSmartStructures,Active SensingandReactive SmartStructures,SmartSkins	10

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Serope Kalpakjian and Schmid- Manufacturing process for Engineering materials Pearson- 2005.
2. Paul Degarmo, Black and Kohsher- Materials and processes in Manufacturing- Wiley Student Edition- 9th Edition- 2005
3. Sami Franssile- Introduction to Micro Fabrication- John Wiley and Sons- UK 2004
4. Harfold Belofsky- Plastic design and processing hand book, Hanser publication- 2005
5. Beck- Plastic Product Design- van Nostrand Reignhold 2nd Edition
6. Asbhay, Selection of Materials, El Sevier Publications, 2006.

Course Code	Course Name	Credits
PDDDLO 1011	**Computer Aided Product Development**	**04**

Objectives

1. To impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc

Outcomes: Learner will be able to…

1. Get familiarized with the computer graphics application in design
2. Understand 3D modeling application in product development.
3. Solve CAE problems that arise in engineering

Module	Detailed Contents	Hrs.
01	**IntroductiontocomputerGraphics:**Definitions,Classification,Architectureof interactive computerGraphics, ApplicationsDisplay&Interactivedevices**ScanConversion:**Pixelplotting,scanconversionof Line,Circle,ellipse,Parabola, Hyperbola.Effects of Scanconversion Polygons:Types,PolygonfillingusingBoundaryfill,edgefill,Floodfillalgorithms,ScanconversionwithRealTimescanconversion,Runlengthencoding,Cellencoding	10
02	**GraphicsProgramming**:-Graphicsfunction,openGLinterface,Co-ordinatesystems, Primitives &Attributes **Transformations**:-2-D Transformations, 3-D Geometric & modelingTransformations	08
03	2-D Viewing&Clipping, 3-D Viewing&Clipping, 3D viewing functions**Projection:** General Projection Transformation, parallel & PerspectiveProjections	08
04	**Curves :**Splines,Bezier &B-Spline Curves **Surfaces**: Visible Surfacedetectionmethods, Hermite,Bezier&B-Spilnesurfaces	08
05	**VirtualReality:**HiddenLines&HiddenSurfaces:Z-Buffer,Painters,RayTracing,Area-Subdivision,ScanLinealgorithmLight,Color&ShadingModels Animation.	10
06	**CAD&GeometricModeling:**FeaturesofModeling&AssemblyPackages,TypesofGeometricModeling,geometry&topology,DataStructures,andProductDataexchangeFormats. **FundamentalsofCAE:**Generalprocedures of Numericalmethods like FEM&FDM,Kinematicanalysis&Animation,FeaturesandApplicationofCommercialpackages ofCAE.	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Computer Grahics by F.S Hill. Jr
2. Computer graphics by Zhigang Xiang & Roy Plastock (Schaum's outline's)
3. Computer Graphics by Hearn & Baker
4. Mathematical elements for Computer Graphics by David F. Rogers, James Alan Adams
5. Procedural elements for Computer Graphics by David F. Rogers, James Alan Adams
6. Mastering CAD/CAM by Ibrahim Zeid
7. Geometric Modelling by Mortenson, M.E.
8. Interactive Computer Graphics by E.Angel & Dave Shreiner.

Course Code	Course Name	Credits
PDDDLO 1012	**Creativity In Design**	**04**

Objectives

1. To highlight the importance of creativity for new product development
2. To study skills needed for enhancing creative thinking and encouraging innovation.

Outcomes: Learner will be able to…

1. Understand the various techniques adopted for stimulating creativity
2. Apply innovative process to the design and development of new products

Module	Detailed Contents	Hrs.
01	**INTRODUCTION:** Needfordesigncreativity–creativethinkingforquality–essentialtheoryaboutdirected creativity	10
02	**MECHANISM OFTHINKING:** Definitionsandtheory of mechanismsof mind heuristicsandmodels : attitudes,Approaches andActions thatsupportcreative thinking	14
03	**VISUALIZATION:** Advancedstudyofvisualelementsandprinciples-line,plane,shape,form,pattern,texturegradation,color Symmetry.Spatialrelationshipsandcompositionsin2and3dimensionalspace - procedureforgenuinegraphicalcomputeranimation–Animationaerodynamics–virtualenvironmentsinscientificVisualization–Unifyingprincipleofdatamanagement for scientificvisualization - Visualizationbenchmarking	09
04	**CREATIVITY:** MethodsandtoolsforDirectedCreativity–BasicPrinciples–ToolsofDirectedCreativity–Toolsthatpreparethemindforcreativethought–stimulationofnewideas–DevelopmentandActions:-ProcessesincreativityICEDIP–Inspiration,Clarification,Distillation,Perspiration,EvaluationandIncubation–CreativityandMotivationTheBridgebetweenmancreativityandtherewardsofinnovativeness–ApplyingDirected Creativityto the challenge of qualitymanagement	08
05	**DESIGN:** ProcessDesign,EmotionalDesign–ThreelevelsofDesign–Viceral,BehavioralandReflective-Recyclingandavailability-Creativityandcustomerneedsanalysis–Innovativeproductandservicedesigns,futuredirectionsinthisapplicationofcreativitythinkingin qualitymanagement	07
06	**INNOVATION:** AchievingCreativity–IntroductiontoTRIZmethodologyofInventiveProblemSolving-theessentialfactors–Innovator'ssolution–creatingandsustainingsuccessfulgrowth–DisruptiveInnovationmodel–SegmentiveModels–Newmarketdisruption-CommoditationandDE-commoditation–Managing theStrategyDevelopmentProcess–TheRoleofSeniorExecutiveinLeadingNewGrowth–PassingtheBaton	04

<u>Assessment</u>:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Rousing Creativity: Think New NowFloyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999
2. Geoffrey Petty," how to be better at Creativity", The Industrial Society 1999
3. Donald A. Norman," Emotional Design", Perseus Books Group New York , 2004
4. Clayton M. Christensen Michael E. Raynor," The Innovator's Solution", Harvard Business School Press Boston, USA, 2003
5. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000.

Course Code	Course Name	Credits

PDDDLO 1013	Die Design And Development	04

Objectives

1. To highlight the importance of Die design in new product development.
2. To impart the skills needed for enhancing creative thinking and encouraging innovation..

Outcomes: Learner will be able to…

1. Understand the various techniques adopted for Die Design.
2. Apply stimulating creativity and innovative techniques to the design and development of die.

Module	Detailed Contents	Hrs.
01	**Introduction to ManufacturingProcess:** Shearing,MechanicsofShearing,ShearingForces,BlankingandPunchingMechanisms, Bending,MechanicsofDeepDrawing,VariousFormingProcessessuchasStretchFormin g,Nosing,Expanding,Dimpling,Spinning,FlexibleDieForming,BasicDieClassificatio nsand Components	10
02	**Tool and Die Materials:** CarbonandAlloySteels,DesignationsforCarbonandAlloySteels,EffectsofVariousAllo yElementsinSteels,CarbonSteels,AlloySteels,MachinabilityofSteels,MechanicalProp ertiesofSteels,ApplicationsofCarbonandAlloySteels,ToolandDieSteels,Designationa ndClassificationofToolandDieSteels,ColdWork Tool andDie Steels,Nonferrous Metals, Non-metallic Materials	12
03	**Design ofBlankingandPunchingDies:** DieBlocks,DieOpeningProfile,FasteningtotheDieShoe,SectionedDie,CalculationofD ieBlockDimensions,Punches,PunchFace,Geometry,MethodsforAssemblingPunches, PunchCalculations,StripperPlates,StripperForce,StripperDesign,DieComponentsfor GuidingandStopping,StockGuidesandGuideRails,DieStopsandFrenchNotchPunch,P ositioningtheIndividualBlank,Pilots, Centreof DiePressure,Examples of CoutingDieDesigns	08
04	**DesignofBendingDies:** SimpleDieDesigns,U-ProfileBendDies,V-profileBendDies,UniversalBendingDies,DiesofComplexDesign,ClosingProfileDies,Special BendingDies,CurlingandHingeDies,Tube-formingDies,Multiple-bendDies,CombinationDies,ProgressiveDies	08
05	**Deep Drawing Dies:** DrawRings,DrawRingswithCornerRadius,DrawRingswithConicalProfile,Clearances andTolerances,CalculationoftheDimensionsofthePunchandDie,BlankHolders,Blank HolderPressure,BlankHolderForce,DrawBeads,Single-operationDies,Multi-operationDies,ProgressiveDies,IroningDies,DrawingDiesforPieces	08
06	**VariousFormingDies:** NosingDies,ExpandingandBulgingDies,ExpandingDies,BulgingDies,FlangingDies **Die Process Quality AndAutomation, DieMaintenance:** LimitSwitches,Sensors,Vision Control, Automation andIn-Die Processes,Automated QualityControl, Die Maintenance andAdjustments, Role ofSoftware'sin Die Design	06

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Ivana Suchy, "Handbook of Die Design" 2006, McGraw Hill, ISBN 0-07-146271-6
2. VukotaBoljanovic, "Sheet Metal Forming Processes and Die Design", Industrial Press, New York, ISBN 0-83 1 1-3 182-9
3. Joseph Vincent Woodworth, "Dies, Their Construction and Use for the Modern Working of sheet Metals; A Treatise on the Design, Construction and Use of Dies, Punches", 2010, Cambridge Scholars Publishing, ISBN-13 9781152026681
4. David Smith, "Die Design Handbook" 3rd Edition, 1990, Society Of Manufacturing Engineers, ISBN-13 9780872633759
5. VukotaBoljanovic , "Die Design Fundamentals" 3rd Edition, 2005, Industrial Press, ISBN-13 9780831131197.

Course Code	Course Name	Credits
PDDDLO1014	**Product Packaging**	**04**

Objectives

1. To study the importance of product packaging in new product development .
2. To study skills needed to creative packaging for new products.

Outcomes: Learner will be able to…

1. To understand the various techniques for packaging foe a new product.
2. To apply quality assessment and testing techniques to the design and development of new products

Module	Detailed Contents	Hrs.
01	**Introduction :Definition** FunctionsofPackaging,packageenvironmentProduct&Packaging,MaterialCharacteristics,PackagingEvaluation.	10
02	**PackagingMedia(Science,Technology,Manufacture,Conversion,Properties&Applications):** Paper&Board,FibreBoardBoxes,CompositeContainers,Drums,Celluloses,Glass,MetalContainersandComponents,PolymersandPlastics,FlexiblePackagingMaterials,WoodenContainers,Crates,IBCs,Flexible&Rigid,Textiles andJute.	09
03	**Quality Assessment&Performance Evaluation:** Testing,SignificanceofTesting,QualityControlandQualityAssurance,SQCTechniques,Shelf-lifeEvaluation,ProductPackageCompatibility,Migration,Transport-worthinessTesting,TestingofAncillaryMaterials,MachineMaterialInteraction,IMDG, UN/IATATesting,etc.	07
04	**PackagePrinting:** Pre-Press,PrintingProcesses,Letterpress,Offset,Lithography,Flexography,Gravure,Screen,Pad,FoilStamping,DigitalPrinting(Inkjet,Thermal),Computer-to-Plate.ColourManagement,ColourMeasurement,etc. **PackageGraphics:** PackageDesign,RoleofGraphics,PackageAesthetics,DecorationAspects,LayoutandFeature Selection,etc.	10
05	**Package Storageand Handling:** StorageTypes,DamageControl, WarehousingandHandling Equipments&Techniques,etc.	07
06	**Packaging&Environment:** EcoIssues,Wastage Control, Wastage Disposal, Eco FriendlyPackaging, etc.	09

Assessment:

Internal:
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End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Walter Soroka, "Fundamentals of packaging technology", 3rd Edition, Institute of Packaging professionals, Naperville, Illinois, USA, 2002.
2. Giles Calver, "What is Packaging Design? Essential design handbook", Rotovision, 2004
3. Steven DuPuis, John Silva,"Package Design Workbook: The Art and Science of Successful Packaging", Rockport Publishers, 2008.
4. William H.Erdei, "Bar Codes – Design, Printing and Quality Control", McGrawHill inc., 1998.
5. Joseph F. Hanlon, Robert J. Kelsey, Hallie Forcinio, "Handbook of Packaging Engineering", 3rd edition, CRC Press, 1998
6. Ronald E.Tood," Printing Inks – Formulations, Principles, Manufacture, and Quality Control Testing," PIRA International1996
7. Davis, C.G., "Introduction to Packaging Machinery", Packaging Machinery Manufacturers Institute, 1997
8. M.Bakker, "Wlley Encyclopedia of Packaging Technology", Joh Wiley & Sons Ltd., 2008
9. Sugan E. M.Solke, "Packaging and the Environment, Alternatives, Trends and Solutions", Technomic Publication, Revised Edition, 1994.
10. Nigel Thoobald, "Packaging closures & Sealing systems", CRC Publishers, 2006erbert F. Lund, "McGraw-Hill Recycling Handbook", 2nd Edition, 2001.

Course Code	Course Name	Credits
ILO 1011	**Product Life Cycle Management**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Introduction to Product Lifecycle Management (PLM):**Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications **PLM Strategies:**Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10
02	**ProductDesign:**Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	**Product Data Management (PDM):**Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	**Virtual Product Development Tools:**For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	**Integration of Environmental Aspects in Product Design:**Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	**Life Cycle Assessment and Life Cycle Cost Analysis:**Properties, and Framework of LCA, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

Assessment:

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Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper.Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1012	**Reliability Engineering**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Probability theory:** Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	05

Assessment:

Internal:
Assessment consists of two tests out of which; one should be compulsory class test and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1013	**Management Information System**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

Assessment:

Internal:

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End Semester Theory Examination:

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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1014	**Design of Experiments**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Introduction** 1.1 Strategy of Experimentation 1.2 Typical Applications of Experimental Design 1.3 Guidelines for Designing Experiments 1.4 Response Surface Methodology	06
02	**Fitting Regression Models** 2.1 Linear Regression Models 2.2 Estimation of the Parameters in Linear Regression Models 2.3 Hypothesis Testing in Multiple Regression 2.4 Confidence Intervals in Multiple Regression 2.5 Prediction of new response observation 2.6 Regression model diagnostics 2.7 Testing for lack of fit	08
03	**Two-Level Factorial Designs and Analysis** 3.1 The 2^2 Design 3.2 The 2^3 Design 3.3 The General2^k Design 3.4 A Single Replicate of the 2^k Design 3.5 The Addition of Center Points to the 2^k Design, 3.6 Blocking in the 2^k Factorial Design 3.7 Split-Plot Designs	07
04	**Two-Level Fractional Factorial Designs and Analysis** 4.1 The One-Half Fraction of the 2^k Design 4.2 The One-Quarter Fraction of the 2^k Design 4.3 The General 2^{k-p} Fractional Factorial Design 4.4 Resolution III Designs 4.5 Resolution IV and V Designs 4.6 Fractional Factorial Split-Plot Designs	07

05	**Conducting Tests** 5.1 Testing Logistics 5.2 Statistical aspects of conducting tests 5.3 Characteristics of good and bad data sets 5.4 Example experiments 5.5 Attribute Vs Variable data sets	07
06	**Taguchi Approach** 6.1 Crossed Array Designs and Signal-to-Noise Ratios 6.2 Analysis Methods 6.3 Robust design examples	04

Assessment:

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End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1015	**Operations Research**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Introduction to Operations Research**: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming**: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, **Duality**, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem**: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem**: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem **Integer Programming Problem**: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	14
02	**Queuing models**: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	**Simulation**: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	**Dynamic programming**. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	**Game Theory**. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05

06	**Inventory Models**: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

Assessment:

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End Semester Theory Examination:
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1016	**Cyber Security and Laws**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime andinformation security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation ofMobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed byMobile Devices, Registry Settings for Mobile Devices, AuthenticationService Security, Attacks on Mobile/Cell Phones, Mobile Devices:Security Implications for Organizations, Organizational Measures forHandling Mobile, Devices-Related Security Issues, OrganizationalSecurity Policies and Measures in Mobile Computing Era, Laptops	9
03	**Tools and Methods Used in Cyberline** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6
04	**The Concept of Cyberspace** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law , The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	**Indian IT Act.** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	**Information Security Standard compliances** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

Assessment:

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End Semester Theory Examination:
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4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
ILO 1017	**Disaster Management and Mitigation Measures**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	Introduction ***1.1*** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: 2.1 Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **2.2** Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09
03	Disaster Management, Policy and Administration 3.1 Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. 3.2 Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management program.Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India.Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: 5.1 Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. 5.2 International relief aid agencies and their role in extreme events.	09

06	**Preventive and Mitigation Measures:** 6.1 Pre-disaster, during disaster and post-disaster measures in some events in general 6.2 Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication 6.3 Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. 6.4 Do's and don'ts in case of disasters and effective implementation of relief aids.	06

Assessment:

Internal:
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End Semester Theory Examination:
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four question need to be solved.

REFERENCES:

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

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

Course Code	Course Name	Credits
ILO 1018	**Energy Audit and Management**	**03**

Objectives:

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

Outcomes: Learner will be able to…

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

Module	Detailed Contents	Hrs
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	**Energy Management and Energy Conservation in Electrical System:** Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. **Energy efficiency measures in lighting system, Lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03

Assessment:

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4. Only Four question need to be solved.

REFERENCES:

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

Course Code	Course Name	Credits
PDDL101	**CAD:Solid Modelling Lab**	**01**

Simulation study using mathematical simulation software (or any programming language) on any six

1. Create 3-D solid models of complex objects given a multi-view representation (minimum 2 to 3).

Project:For a given system consisting of four to five components do as described below;

1. Create solid models of individual parts
2. Create reference geometry features (planes, axes)
3. Create solid features using sweeping and lofting operations
4. Measure properties of 3-D CAD models
5. Create assemblies of CAD parts with appropriate mating relationships

Assessment:

Weightage for Laboratory Project should be 40% in Final Assessment of Laboratory Work

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
PDDL102	**Rapid Prototyping And Tooling Lab**	**01**

Following activity can be demonstrated either in the Institute or visiting any organization where this type of work is done.

1. Study of reverse engineering concepts
2. Demonstration of 3D scanning
3. Study of rapid prototyping machines
4. Demonstration of Fusion Deposition Modeling
5. Demonstration of Selective Laser Sintering
6. Demonstration of Vacuum casting
7. Demonstration of Virtual Reality

Project: In a group of not more than 4 students

Identify an existing consumer product, develop CAD model, simulate in CAE environment, optimize, develop tooling and make a physical prototype. Prepare a detailed report.

Assessment:

Weightage for Laboratory Project should be 40% in Final Assessmentof Laboratory Work

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
PDDC201	**Quality Concepts In Design**	**04**

Objectives

1. To study importance of various principles of quality in a product or service through.
2. To study application of statistical tools in product development

Outcomes: Learner will be able to…

1. Understand concepts in quality and reliability principles in the design of an engineering product or a service.
2. Apply statistical techniques such as quality houses, control charts, statistical process control method, failure mode effect analysis in new product development process
3. Strategies of designing experiments, methods to uphold the status of six sigma and improve the reliability of a product.

Module	Detailed Contents	Hrs.
01	**DESIGNFOR QUALITY** QualityFunctionDeployment-HouseofQuality-Objectivesandfunctions-Targets-Stakeholders-MeasuresandMatrices-DesignofExperiments–Bench marking.	10
02	**FAILURE MODE EFFECT ANALYSIS** Basicmethods:Refininggeometryandlayout,generalprocessofproductembodiment-Embodimentchecklist- Advancedmethods:systemsmodeling,mechanicalembodimentprinciples-FMEAmethod-linkingfaultstatestosystemsmodeling-Case study-computer monitorstand foradockingstation.	10
03	**DESIGN OFEXPERIMENTS** Designofexperiments-Basicmethods-Twofactorialexperiments-Extendedmethodreducedtestsandfractionalexperiments,orthogonality,basedesignmethod,higherdimensionalfractionalfactorialdesign-Statisticalanalysisofexperiments:Degreeoffreedom,correlationcoefficient,standarderroroftheresidualt-test,ANOVA-ratiotest,otherindicators-residualplots,AdvancedDOEmethodforproducttesting-Productapplicationsofphysicalmodelingand DOE,Blenderpaneldisplayevaluation,coffeegrinderexperimentaloptimization-Taguchimethod.	08
04	**STATISTICAL CONSIDERATION IN PRODUCT DESIGN AND DEVELOPMENT** FrequencydistributionsandHistograms-Runcharts–stemandleafplots-Paretodiagrams-CauseandEffectdiagrams-Boxplots-Probabilitydistribution-StatisticalProcesscontrol–Scatterdiagrams–Multivariablecharts–Matrixplotsand3-D plots.	08
05	**RELIABILITY** Reliability-SurvivalandFailure-Seriesandparallelsystems-Meantimebetweenfailure-Weibulldistributions(Howtocalculateorestimateincomponentlevelsystemlevel introductoryonly)	08
06	**DESIGNFOR SIX SIGMA** BasisofSIXSIGMA–ProjectselectionforSIXSIGMA-SIXSIGMAproblemsolving-SIXSIGMAinserviceandsmallorganizations-SIXSIGMAandleanproduction–LeanSIX SIGMA andservices	08

Assessment:

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4. Only Four questions need to be solved.

References:

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
2. Product Design and Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA McGraw-HILL- 3rd Edition, 2003.
3. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay Pub: son south-western
4. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.

Course Code	Course Name	Credits
PDDC202	**Design For X**	**04**

Objectives

1. To study the concept of design for manufacturing, assembly and environment.
2. To study the product development economics..

Outcomes: Learner will be able to…

1. Apply design concepts for manufacturing, assembly and environment

Module	Detailed Contents	Hrs.
01	**DESIGNFORMANUFACTURE:** Generaldesignprinciplesfor manufacturability-strengthandmechanicalfactors,mechanismsselection, evaluation method,Processcapability - Feature tolerances-Geometrictolerances-Assemblylimits– Datumfeatures -Tolerance stacks	05
02	**DESIGNFOR ASSEMBLY:** Assemblyprocesses-Handlingandinsertion process-Manual, automatic and roboticassembly-Cost of Assembly-Number ofParts-DFA guidelines	10
03	**VALUEENGINEERING:** Value–types–functional–operational–aesthetic–cost-–material–Designprocess–valueandworthiness–procedure-brainstormingsessions–evaluation–casestudies–valueestimation-Valueanalysis-Designforvalue-Selectionofalternatives-optimization – Implementation	11
04	**PRODUCTDEVELOPMENT ECONOMICS:** ElementsofEconomicsanalysis-Quantitativeandqualitativeanalysis-EconomicAnalysisprocess-Estimatingmagnitudeandtimeoffuturecashinflowsandoutflows-Sensitivityanalysis-Projecttrade-offs-Trade-offsrules-Limitationofquantitativeanalysis-Influence of qualitative factorson project success	12
05	**CONCEPTOFRELIABILITY:** Introduction:ThestudyofReliabilityandMaintainability,Concepts,TermsandDefinitions,Applications,TheFailureDistribution:ThereliabilityFunction,MeanTime to Failure, HazardRateFunction,Bath tubCurve, Conditional Reliability	07
06	**MAINTAINABILITY:** Analysisofdowntime,ReportTimeDistribution,StochasticPointProcesses,ReliabilityunderPreventiveMaintenance,State-DependantSystemwithRepair,DesignforMaintainability.	07

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References:

1. Harry Peck, Designing for Manufacture, Pitman Publications, 1983.
2. George E Dieter, Engineering Design, McGraw-Hill Int Editions, 2000
3. S.S.Iyer, Value Engineering, New Age International, 2000
4. Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, TMH 2000.

Course Code	Course Name	Credits
PDDC203	**Applied Ergonomics**	**04**

Objectives

1. To expose the students to the various aspects of Industrial Design so as to develop new products considering aesthetics, ergonomics, environment and other human factors.

Outcomes: Learner will be able to…

1. Understand the importance of ergonomics in the design of new products
2. Learn the effect of biomechanics, biothermodynamics, bioenergetics on the design and development of new products.
3. Understand the effects of other human factors

Module	Detailed Contents	Hrs.
01	**HumanFactors Basics:** Introduction to HumanFactors,Research Methods, DesignandEvaluationTools, VisualSensorySystem, Auditory,Tactile,and Vestibular Systems.	10
02	**Human-Machine System:** Cognition,DecisionMaking,Displays, Control	8
03	**HumanPerformance intheWorkplace:** Anthropometry andWorkplaceDesign,Biomechanicsof Work, Work Physiology,Stress and Workload	10
04	**Ergonomics -Physicaldesign:** User-technologyphysicalinterface design Whoaretheusers?Howdoesthetechnologyfitdifferentuserdimensions?Howdoesthetechnologyfituseranatomy?Howdoesthetechnologyfituserstrength?Howdoesthetechnologyaccommodatedifferentabilities?Howsafeisthetechnology(health,comfort,performance)?Howdo usersinteract with technology?	8
05	**Introduction to the concept of systemdesignand Ergonomics** Ergonomicsinproductdesign,theinterfacedesign,Bodydimensionsanditsapplicationindesign,Dimensionaloptimizationforthepopulationanduseofpercentile,Themusculo-skeletalsystemandjointmotionstudy,Humanbodyfollowingtheprincipleoflever,biomechanicalstressesonourbody.Effectofstressesimposedonbody.Designfromtheviewpointofbiomechanics,Workpostureanalysis,StaticandDynamicwork,thevisual,auditoryandthermalenvironmentandtheirimpactondesign.Controlsanddisplayaspectsofdesign.Researchtechniquesin Ergonomicdatageneration,interpretation andapplication of statisticalmethods.	8
06	**Introduction to basic elements of designand Ergonomics:** Line,texture,colour,form,symmetry,balance,scale,mass,unityandvariety.Conceptofvisuallanguageandvisualdesign.IntroductiontoGestaltlaws,compositionandfigureandgroundrelationships.Introductiontoconceptofnegativespace,Useofsymmetry.Generationofpatternsandtextures usingsimple elements.	8

<u>Assessment</u>:

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References:

1. M. S. Sanders and Ernest J. McCormick: Human Factors in engineering and Design, Sixth Edi.,McGraw-Hill International Editions, 1987.
2. P.O. Astrand and K. Rodahl, Textbook of work physiology, McGraw Hill, New York, 1970.
3. Wickens, C.D., Lee, J.D., Liu, Y., Gordon Becker, S.E. (2004). An Introduction to Human Factors in Engineering (2nd Ed.). Upper Saddle River, New Jersey: Pearson Prentice-Hall

Course Code	Course Name	Credits
PDDDLO 2021	**Vehicle Design**	**04**

Objectives

1. To study automotive engineering development
2. To study application of computers in vehicle design.

Outcomes: Learner will be able to…

1. Select a commercial software for vehicle design
2. Choose material to design vehicle parts

Module	Detailed Contents	Hrs.
01	**Automotiveengineering development:** InnovationandInventions,StylingDevelopment,Streamlining,Engine Developments,TransmissionDevelopments,Steering,Brakes, Suspension, Wheels and Tyres,InteriorRefinement, SafetyDesign	08
02	**Modernmaterials and theirincorporationinto vehicle design:** Structureandmanufacturingtechnologyofautomotivematerials,MetalsandAlloys,PlasticsandPolymers,CeramicsandGlasses,CompositeMaterials,MechanicalandPhysical Properties ofAutomotive Materials,Selection ofAutomotive Materials	10
03	**Body design: The stylingprocess:** TheStudios,workingenvironmentandstructure,ProductPlanning,Conceptsketchingand Packagerelatedsketching,Fullsizedtapedrawing,ClayModelling,Useof2DCAD system, Useof 3D CAD System,Rendering Techniques	10
04	**Body design: Aerodynamics:** Aerodynamicforces,Drag,Drag reduction,Stability andcross winds, Noise,Ventilation, Wind tunneltesting, UseofCFD **Basic Concepts inDesignand Analysis:** Chassis,Suspensionsystems,Brakingsystems,Transmissionanddriveline,NoiseandVibration	08
05	**Occupantaccommodation: anergonomics approach:** ErgonomicsinAutomotiveIndustry,Ergonomicmethodsandtoolstopromoteoccupantaccommodation,Standards, Guidelines andRecommendations,Anthropometry, Testing	08
06	**Futuretrends inautomobile design:** Mechanicalpossibilities,Advances in ManufacturingMethods, Materialsadvances,Energyconservation,Powersystems,Electrical,Electronic andHybrid possibilities,Vehicleinformation andnavigationsystems	08

Assessment:

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References:

1. Julian Happian-Smith , "An Introduction to Modern Vehicle Design", 2002, Butterworth-Heinemann, ISBN 07506 5044 3
2. John Fenton, "Advances in Vehicle Design", 1999, Professional Engineering Publishing, ISBN-13 9781860581816
3. Sanders, M.S. and McCormick, E.J., "Human Factors in Engineering and Design" (7th edition) McGraw-Hill
4. Smith, W.F. (1993). "Fundamentals of Materials Science and Engineering." McGraw-Hill
5. ,ISBN 0-07-059202-0
6. Beranek, L.L. (1971). "Noise and Vibration Control". McGraw-Hill.
7. Bralla, J.B. (ed.) (1986). "Handbook of Product Design for Manufacturing – a Practical Guide to Low Cost Production." McGraw-Hill. ISBN 0-07-007130-6.
8. Ryan Boroff, Tony Lewin, "How to Design Cars Like a Pro",2010, Motorbooks International, ISBN-13 9780760336953
9. Geoff Wardle, Freeman Thomas, Stacey Macey, Ralph Gilles, Gordon Murray, Stuart Macey, "H-point: The Fundamentals of Car Design and Packaging",2009, Ingram Pub Services, ISBN- 13 9781933492377
10. MR Fernando F. Palma P., "Car Design: Futuristic Concepts",2009, Createspace, ISBN-13 9781448618767
11. Bilal Salim, "Design and Fabrication of a Hybrid Car",2012, LAP Lambert Academic Publishing, ISBN-13 9783659157264

Course Code	Course Name	Credits
PDDDLO2022	**Polymeric Materials And Processing**	**04**

Objectives

1. To study the behavior of polymeric materials
2. To study the applicability of polymers for various industrial applications
3. To study the effect of polymeric materials on the environment and vice versa

Outcomes: Learner will be able to…

1. Select an appropriate polymeric material for a given application
2. Choose an appropriate process to fabricate a product from the polymeric material
3. Select an appropriate testing method to evaluate a given property of a polymeric material
4. Develop the methods to minimise the effect of polymeric materials on the environment and vice versa.

Module	Detailed Contents	Hrs.
01	**Introduction** Terminology of plastics, Early history of polymers, Development of plastic products, Designing a polymer structure for improved properties , Plastic properties - Mechanical Properties, Reinforced Properties, Electrical properties, Optical properties, Thermal Properties	8
02	**Polymer Characterization** Solubility and swelling, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, analysis of polymers using IR, XRD, thermal (DSC, DMTA, TGA), microscopic (optical and electronic) techniques.	8
03	**Industrial Polymers** Addition polymers - Polyolefins, Olefins copolymers, Acrylic, Vinayl polymers. Condensation polymers - Polyesters, polyamides, formaldehydes resins Polyurethanes, Eather polymers, cellulosic Polymer, Silicones, Polyblends Interpenetrating polymer Network. Polymers in special uses - High temperature and fire resistance, liquid crystal Polymers, electro active polymer, Polymer supported catalysts, Optical information storage.	10
04	**Fabrication Processes** Types of processes, tooling for plastic processing, compression moulding, Transfer moulding, Injection moulding of thermoplastics, Injection moulding of thermosetting resins, Extrusion, Pultrusion, Blow Moulding, Calendaring,Rotational moulding, Thermoforming, Casting process, Foaming Process, Reinforcing process	10
05	**Polymer Testing** Mechanical - static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity - thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.	10
06	**Plastics and Environment** Effect of plastics on the environment, effect of environmental factors on the behaviour of plastics in outdoor environment, behaviour of plastics in the biotic environment, behaviour of plastics in the fire environment	6

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4. Only Four questions need to be solved.

References:

1. Industrial Polymers, Specialty Polymers, and Their Applications Manas Chanda and Salil K. Roy CRC Press 2008 Print ISBN: 978-1-4200-8058-2 eBook ISBN: 978-1-4200-8059-9
2. Plastics and the Environment Anthony L. Andrady ISBN: 978-0-471-09520-0
3. Design of Plastic Products Charles A. Harper: Modern Plastics Handbook, McGraw-Hill Professional, 2000
4. Life Cycle Engineering of Plastics: Technology, Economy and Environment Edited By L. Lundquist Y. Leterrier P. Sunderland Imprint: Elsevier ISBN: 978-0-08-043886-3
5. Plastic product design Ronald D. Beck Van Nostrand Reinhold Co., 1980 - Technology & Engineering -3 .Plastics Technology Handbook, Third Edition, edited by Manas Chanda, Salil K. Roy
6. Plastics and the Environment, Anthony L. Andrady, John Wiley & Sons
7. Raw Materials for Industrial Polymers, H. Ulrich, Hanser Publication1989.
8. Polymer Science, V.R. Gowarikar, John wiley and Sons 1986.
9. Polymer Chemistry, Malcolm P. Stevens, Oxford University Press, Inc, 1990.
10. Handbook of polymer Testing, Roger Brown, Marcel Dekker Inc, 1999

Course Code	Course Name	Credits
PDDDLO 2023	**Reverse Engineering**	**04**

Objectives

1. To study Understand the Reverse Engineering (RE) Methodology.
2. To study patent and copy right issues.

Outcomes: Learner will be able to…

1. Understand of basic engineering systems.
2. Apply the terminologies related to re-engineering, forward engineering, and reverse engineering.
3. Understand Reverse Engineering methodologies.
4. Apply Reverse engineering in Mechanical Systems..

Module	Detailed Contents	Hrs.
01	**Introduction** HistoricalBackground,IndustrialEvolution,ReinventionofEngineeringMarvelsfrom Nature,ReverseEngineeringinModernIndustries,ReverseEngineeringvs.MachineDesign,MotivationandChallenge,AnalysisandVerification,Accreditation,PartCriticality, Applications of ReverseEngineering	07
02	**GeometricalForm** SurfaceandSolidModelReconstruction,ScanningInstrumentsandTechnology,PrinciplesofImaging,Cross-SectionalScanning,DigitalData,ComputationalGraphicsandModeling,DataRefinementandExchangeability,DimensionalMeasurement,CaseStudies,PartTolerance,Prototyping,AdditivePrototypingTechnologies,SubtractivePrototypingProcesses,RapidInjectionMolding,StepsofGeometric Modeling	08
03	**Material Characteristics and Analysis** Alloy StructureEquivalency,PhaseFormationandIdentification,MechanicalStrength,Hardness **PartDurability and LifeLimitation** PartFailureAnalysis,Fatigue,CreepandStressRupture,EnvironmentallyInducedFailure	10
04	**MaterialIdentificationandProcessVerification** MaterialSpecification,Composition Determination,MicrostructureAnalysis,ManufacturingProcessVerification	12
05	**DataProcess and Analysis** StatisticalAnalysis,Data Analysis,Reliability andthe Theory of Interference,Weibull Analysis, DataConformityandAcceptance, Data Report **PartPerformance and SystemCompatibility** Performance Criteria, Methodology of Performance Evaluation, System Compatibility	08
06	**Acceptance and Legality** LegalityofReverseEngineering,LegalDefinitionofReverseEngineering,LegalPrecedentsonReverseEngineering,Patent,Copyrights,CopyrightCodes,LegalPrecedents onCopyrights,Trade Secret, Case StudyofReverse Engineering aTradeSecret, Third-PartyMaterials	07

Assessment:

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1. Wego Wang, "Reverse Engineering: Technology of Reinvention", ISBN-13: 978-1439806302, CRC Press
2. Kevin Otto , "Product Design : Techniques in Reverse Engineering and New Product Development", ISBN-13: 9788177588217, Dorling Kindersley
3. Robert Messler, "Reverse Engineering: Mechanisms, Structures, Systems &Materials", McGraw Hill Education, ISBN: 9780071825160
4. Raja, Vinesh, Fernandes, Kiran J. , "Reverse Engineering An Industrial Perspective" ISBN 978-1-84628-856-2, Springer

Course Code	Course Name	Credits
PDDDLO2024	**Product Marketing**	**04**

Objectives

1. To provide the student with an overview of marketing research techniques.
2. To impart fundamental knowledge of marketing research and its application in the front end of product development

Outcomes: Learner will be able to…

1. Choose appropriate marketing analysis tools.
2. Understand consumer behaviour and need for product development
3. Select pricing for products and services

Module	Detailed Contents	Hrs.
01	**AdvancedMarketing Planning** **Introduction:**Concept,nature,scopeandimportanceofmarketing;Marketingconceptanditsevolution;Marketingmix;Strategicmarketingplanning–anoverview. **MarketAnalysisand Selection:**Marketingenvironment–macroandmicrocomponentsandtheirimpactonmarketingdecisions;Marketsegmentationandpositioning;	08
02	**Consumer Behaviour** Introductionto ConsumerBehaviour(CB):NatureandImportanceof CB,application ofCBin Marketing,ConsumerResearchprocess. ConsumerDecision makingProcess: · Problemrecognition · InformationSearchProcess and Evaluation · Purchasingprocess · Post purchase behaviour	08
03	**MarketingResearch** AnoverviewoftheMarketingResearchProcess,ResearchDesigns,ExploratoryResearch, Descriptive Research,ExperimentalResearch, UncontrollableVariables: History,Maturation,TestingEffect,MeasurementofVariationandInteractiveEffect.TypesofData-PrimaryDataandSecondaryData,SecondaryDataSourcesforMR inIndia.	08
04	**PricingStrategies** AnIntroduction to PricingBasicFrameworksOverview of common pricingmethodsPsychologyand Measurement Therole of consumer psychologyin pricingPrice Discrimination Effective market segmentationNewproduct pricingandbuilding	08
05	**BrandStrategy** ConceptofBrand,SignificanceofBrandingforConsumersandforFirms,BrandingChalle	08

	ngesandOpportunities,ConceptofBrandEquity,Costbased,Price basedandCustomerbasedBrand Equity,CustomerBasedBrand Equity SourcesofBrandEquity-BrandAwarenessandBrandImage,Keller'sCBBEModel-Identity, Meaning,ResponseandRelationships.Br and Positioning DefinitionofTargetMarket&MarketSegmentation,DefiningtheCompetitiveFrame of Reference, Establishingthe Points of Parity&Points of difference.	
06	**Designing the SupplyChainnetwork** UnderstandingthesupplyChain,Designingthedistributionnetwork,Designingand PlanningTransportation Network	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Kotlar, Philip, Marketing Management, Prentice Hall, New Delhi.
2. Loudan, David L and Bitta, A.J. Della Consumer Behaviour
3. Schiffman LG and Kanuk LL Consumer Behaviour
4. Nair, Suja R, Consumer Behaviour in Indian
5. Marketing Research: Text & Cases, Boyd, Westfall & Stasch, R D Irwin
6. Research For Marketing Decisions, Green & Tull, Prentice Hall
7. Thomas T. Nagle, the Strategy and Tactics of Pricing, Prentice Hall
8. Pricing a Portfolio of Products complements & substitutes new product pricing
9. Strategic Brand Management, Keller, Parmeswaran & Jacob, Pearson
10. Brand Management, Kirti Dutta, Oxford Publishing
11. Supply Chain Management Strategy, Planning and Operationby Sunil Chopra, Pearson Education.

Course Code	Course Name	Credits
ILO 2021	**Project Management**	**03**

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to…

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	**Project Management Foundation:** Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	**Initiating Projects:** How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	**Project Planning and Scheduling:** Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	**Planning Projects:** Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	**5.1 Executing Projects:** Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. **5.2 Monitoring and Controlling Projects:** Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. **5.3 Project Contracting** Project procurement management, contracting and outsourcing,	8
06	**6.1 Project Leadership and Ethics:** Introduction to project leadership, ethics in projects. Multicultural and virtual projects. **6.2 Closing the Project:** Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Course Code	Course Name	Credits
ILO 2022	**Finance Management**	**03**

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to…

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	**Overview of Indian Financial System:** Characteristics, Components and Functions of Financial System. **Financial Instruments:** Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. **Financial Markets:** Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market **Financial Institutions:** Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	**Concepts of Returns and Risks:** Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. **Time Value of Money:** Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	**Overview of Corporate Finance:** Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. **Financial Ratio Analysis:** Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	**Capital Budgeting:** Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) **Working Capital Management:** Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	10
05	**Sources of Finance:** Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. **Capital Structure:** Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	**Dividend Policy:** Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
ILO2023	**Enterpreneurship Development and Management**	**03**

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to…

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	**Overview Of Entrepreneurship:** Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	**Business Plans And Importance Of Capital To Entrepreneurship:** Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur **Entrepreneurship And Business Development:** Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	**Indian Environment for Entrepreneurship:** key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	**Effective Management of Business:** Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	**Achieving Success In The Small Business:** Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. PoornimaCharantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. LaghuUdyogSamachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Course Code	Course Name	Credits
ILO2024	**Human Resource Management**	**03**

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to…

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	**Introduction to HR** • Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. • Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5
02	**Organizational Behavior (OB)** • Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues • Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness • Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. • Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); • Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. • Case study	7
03	**Organizational Structure &Design** • Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. • Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. • Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	**Human resource Planning** • Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale. • Performance Appraisal Systems: Traditional & modern methods, Performance Counseling, Career Planning. • Training & Development: Identification of Training Needs, Training Methods	5

05	**Emerging Trends in HR** • Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment • Cross Cultural Leadership and Decision Making**:** Cross Cultural Communication and diversity at work**,** Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	**HR & MIS** Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries **Strategic HRM** Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals **Labor Laws & Industrial Relations** Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
ILO2025	**Professional Ethics and Corporate Social Responsibility (CSR)**	**03**

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to…

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	**Professional Ethics and Business:** The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	**Professional Ethics in the Marketplace:** Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy **Professional Ethics and the Environment:** Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	**Professional Ethics of Consumer Protection:** Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy **Professional Ethics of Job Discrimination:** Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	**Introduction to Corporate Social Responsibility:** Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	**Corporate Social Responsibility:** Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	**Corporate Social Responsibility in Globalizing India:** Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
ILO2026	**Research Methodology**	**03**

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle.Research methods vs Methodology **1.2** Need of Research in Business and Social Sciences **1.3** Objectives of Research **1.4 Issues** and Problems in Research **1.5** Characteristics of Research:Systematic, Valid, Verifiable, Empirical and Critical	**09**
02	**Types of Research** **2.1**. Basic Research **2.2**. Applied Research **2.3.** Descriptive Research **2.4.** Analytical Research **2.5**. Empirical Research **2.6** Qualitative and Quantitative Approaches	**07**
03	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	**07**
04	**Research Methodology** **4.1** Meaning of Research Methodology **4.2**. Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f**. Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	**08**
05	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	**04**
06	**Outcome of Research** **6.1** Preparation of the report on conclusion reached **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	**04**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd ed), Singapore, Pearson Education

Course Code	Course Name	Credits
ILO2027	**IPR and Patenting**	**03**

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to…

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	**Introduction to Intellectual Property Rights (IPR)**: Meaning of IPR, Different category of IPR instruments - Patents, Trademarks,Copyrights, Industrial Designs, Plant variety protection, Geographical indications,Transfer of technology etc. **Importance of IPR in Modern Global Economic Environment:** Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	**Enforcement of Intellectual Property Rights:** Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) activein IPR enforcement **Indian Scenario of IPR:**Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	**Emerging Issues in IPR:**Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	**Basics of Patents:**Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	**Patent Rules:** Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	**Procedure for Filing a Patent (National and International):** Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement **Patent databases:** Important websites, Searching international databases	07

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

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4. Only Four questions need to be solved.

References:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. PrabhuddhaGanguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, PritiMathur, AnshulRathi**,** IPR: Drafting,Interpretation of Patent Specifications and Claims**,** New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers,IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Course Code	Course Name	Credits
ILO 2028	**Digital Business Management**	**03**

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to …..

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	**Introduction to Digital Business-** Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, **Drivers of digital business**- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	**Overview of E-Commerce** **E-Commerce-** Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06
3	**Digital Business Support services**: ERP as e –business backbone, knowledge Tope Apps, Information and referral system **Application Development:** Building Digital business Applications and Infrastructure	06
4	**Managing E-Business**-Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	**E-Business Strategy**-E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	**Materializing e-business: From Idea to Realization**-Business plan preparation **Case Studies and presentations**	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. A textbook on E-commerce**,** ErArunrajan Mishra, Dr W K Sarwade,Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, VinocenzoMorabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Course Code	Course Name	Credits
ILO2029	**Environmental Management**	**03**

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to…

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test **(on minimum Two Modules)** and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. **In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of total six question
2. All question carry equal marks
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,**T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015

Course Code	Course Name	Credits
PDDL201	**CAD: Surface Modelling Lab**	**01**

Introduction to surface modelling

1. Coordinate transformations (translation, rotation, scaling, reflection)
2. Working with drawings, views, dimensions and tolerances.
3. Sheet metal design
4. Surface Modelling

Project:

1. Create CAD models of any two given objects involving above features, such as car side mirror body, mouse body, bottles etc.

Assessment:

Weightage for Laboratory Project should be 40% in Final Assessment ofLaboratory Work

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
PDDL202	**Computer Aided Engineering Lab**	**01**

Introduction to computer aidedengineering

1. Modellingof anelement/system
2. FiniteElementAnalysisofanelement/system(Involveselementselection,assigningproperties,meshing,assigningloadsandboundaryconditions,analysisandresult interpretation)
3. Optimizationofanelement/system(minimizationofmass)throughFEA.

Project:Selectanyengineeringelement/systemandoptimizethedesignthroughFEAapproach

Assessment:

Weightage for Laboratory Project should be 40% in Final Assessment of Laboratory Work

End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
PDDS301	**Seminar**	**03**

Guidelines for Seminar

- Seminar should be based on thrust areas in Mechanical Engineering (Product Design and Development aspect is appreciated)
- Students should do literature survey and identify the topic of seminar and finalize in consultation with Guide/Supervisor. Students should use multiple literature and understand the topic and compile the report in standard format as per University Guidelines for report writing and present in front of pair of Examiners appointed by the Head of the Department/Institute of respective Programme.
- **Seminar should be assessed jointly by the pair of Internal and External Examiners**
- Seminar should be assessed based on following points
  - Quality of Literature survey and Novelty in the topic
  - Relevance to the specialization
  - Understanding of the topic
  - Quality of Written and Oral Presentation

Course Code	Course Name	Credits
PDDD301/ PDDD401	**Dissertation (I and II)**	**12 + 15**

Guidelines for Dissertation

- Students should do literature survey and identify the problem for Dissertation and finalize in consultation with Guide/Supervisor. Students should use multiple literatures and understand the problem. Students should attempt solution to the problem by analytical/simulation/experimental methods. The solution to be validated with proper justification and compile the report in standard format.

Guidelines for Assessment of Dissertation I

- Dissertation I should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization
  - Clarity of objective and scope
- Dissertation I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department/Institute of respective Programme.

Guidelines for Assessment of Dissertation II

- Dissertation II should be assessed based on following points
  - Quality of Literature survey and Novelty in the problem
  - Clarity of Problem definition and Feasibility of problem solution
  - Relevance to the specialization or current Research / Industrial trends
  - Clarity of objective and scope
  - Quality of work attempted
  - Validation of results
  - Quality of Written and Oral Presentation
- Dissertation II should be assessed through a presentation jointly by Internal and External Examiners appointed by the University of Mumbai

Students should publish at least one paper based on the work in reputed International / National Conference (desirably in Refereed Journal)

Desertation Report has to be prepared strictly as per University of Mumbai report writing guidelines.