

COURSE STRUCTURE

B.TECH.

MECHANICAL ENGINEERING

Specialization

in

SMART MANUFACTURING (MFG)

Under

Choice Based Credit System (CBCS)

Program Elective

S. NO.	CODE	SUBJECT	TEACHING SCHEME				CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J			
Bouquet: MANUFACTURING (MFG)									
THEORY									
1.	BMEG0900	Product Design & Development	5	0	0	0	5	5	
2.	BMEG0901	Product Design & Manufacturing	5	0	0	0	5	5	
3.	BMEE0900	Product Design & Development	4	0	0	0	4	4	
4.	BMEE0901	Product Design & Manufacturing	4	0	0	0	4	4	
5.	BMEE0902	Injection Mold Design	4	0	0	0	4	4	
6.	BMEE0903	Press Tool Design	4	0	0	0	4	4	
7.	BMEE0904	Press Tool Design-II	4	0	0	0	4	4	
8.	BMEE0905	Smart Manufacturing	4	0	0	0	4	4	

BMEG – 0900: PRODUCT DESIGN & DEVELOPMENT

Prerequisites: The knowledge of engineering drawing and to understand, ability to read technical drawing.

Objectives: To learn the sketcher workbench, part modeling and designing, wireframe and Surfacing for designing, assembly designing, & Drafting workbench.

Credits: 05

L-T-P: 5:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Part Modeling - Introductions to 3D Experience Software, File Management, Rotate, Zoom, Fit, Refresh, Delete, Undo, Redo Shaded View, Wire frame, Toolbar, sketching tool- line, profile, arc, centerline, Rectangle, Spline, Ellipse, Conics, Trim, Fillet, symmetry, Offset, Break, Create & Modify Dimension, Fix, Horizontal, Vertical, Parallel, Perpendicular, coincidence, symmetric, Tangent, Collinear, concentric. Pad, Pocket, Edge Fillet, variable Radius Fillet, Tritangent Fillet, Face-Face Fillet, Chamfer, Edit Parameter, Edit Sketch, Delete, Isolate, Multi Pocket, Multi-Pad, Shaft, Groove, Hole Creating Points, Reference Lines, Reference, Planes, Rib, Slot, Stiffener, Combined Solid, Multi-section Solid, and Multi-section cut Models, Draft Shell, Thickness, Thread, Mirror, Scaling, Translate Bodies, Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, and User Pattern.	22
II	Wireframe & Surface Design - Circle, Splines, Helix, Corner, Connect Curve, Projection, and Intersection, Extrude, Revolved, Spherical, Cylindrical, Offset, Fill, Swept, Loft, Blend, Join, Split, Trim, Healing, Un-trim, Disassemble, Boundary, Extract, Split, Thick Surface, Closed Surface, Sew. Assembly - Snap, Smart Move, Constraining, Joints- Pin, Prismatic, Cylindrical. Drafting: Generations of views, Auxiliary View, Sections view, Detail view, Partial View, Broken view, Create Dimension, Create note, Generating Layouts	18

Text Books:

- Catia v5 design fundamentals: a step by step guide by JaecheolKoh.

Reference Books:

- CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal Design, and Surface Design, Create Space Independent Publishing Platform (September 13, 2015)

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2.

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

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the basic commands of sketcher Workbench.	PO1, PO7, PO6/ PSO1	U	F,C	8
2	Understand and analysis the part modeling and designing in CATIA.	PO1,PO6, PO7/ PSO1	U	C	6
3	Describe the various methods to learn wireframe and Surfacing for designing.	PO1,PO7/ PSO1	U	C,P	6
4	Develop the various part of assembly design and learn the respective commands.	PO1/ PSO1	Ap	C,P, D	8
5	Describe the various methods to learn Drafting workbench.	PO1,PO5/ PSO2	U	C,P	6
6	Develop the various part of conceptual designing and learn the respective commands.	PO1,PO5/ PSO2	Ap	F,C,P, D, S	6

BMEG – 0901: PRODUCT DESIGN & MANUFACTURING

Prerequisites: The knowledge of manufacturing & design processes. To understand, ability to read technical drawing and part modelling

Objectives: To learn parametric modelling, mechanism design & simulation, Sheetmetal Model Fundamentals, Creating Primary and secondary Sheetmetal Wall Features, Bending and Unbending Sheetmetal Models, Form features and modifying sheet metal models, the process of Sheetmetal Setup and Tools and Detail sheet metal design & Computer Aided Manufacturing

Credits: 05

L-T-P: 5:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Parametric Modeling: Introduction to parametric modeling, declaring user defined parameter, integrating user defined parameters with designed model, applying relation with parameters, Defining the law using algebraic equations, Creating design table using current parameters, Importing the existing design table, Mirror, Scaling, Translate Bodies. Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, User Pattern. Sheet metal Design: Sheet metal Model Fundamentals, Creating Primary Sheet metal Wall Features, Creating Secondary Sheet metal Wall Features, Bending and Unbending Sheet Metal Models, Sheet metal Form Features, Modifying Sheet Metal Models, Sheet metal Setup and Tools, Detail sheet metal designs.	20
II	Manufacturing: Manufacturing Process Overview, Creating Manufacturing Models, Configuring Operations, Using Reference Models, Using Work Piece Models, Creating and Using NC Model Assemblies, Creating and Configuring a Work Center, Creating and Configuring Tools, Using Manufacturing Parameters. NC Sequencing: Creating Face Milling Sequences, Creating Volume Milling Sequences, Creating Profile Milling Sequences, Creating Straight Cut Surface Milling Sequences, Advanced Surface Milling Options, Creating Roughing and Re-roughing Sequences, Creating Finishing Sequences, Creating Hole making Sequences, Using the Process Manager, Creating and Post-Processing CL Data Files.	20

Text Books:

- Advanced CATIA V5 Workbook: Knowledge ware , by Richard Cozzens
- Computer Numerical Control Programming Basics by Steve Krar Arthur Gill

Reference Books:

- Manufacturing Technology - Vol. 1 by PN Rao
- Manufacturing Technology - Vol. 2 by PN Rao

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to:

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the basic commands to learn the advance part modeling.	PO1, PO7, PO6/ PSO1	U	F,C	6
2	Analyze and understand the advance wire frame and surfacing	PO1,PO7/ PSO1	An	C,P,M,S	8
3	Develop the various to learn parametric modeling	PO1/ PSO1	U	F,C,P, D	6

4	Describe the various methods to learn Computer Aided Manufacturing (CAM)	PO1/ PS01	U	C,P	6
5	Understand the basic commands to learn integrated design and Manufacturing	PO1,PO5/ PS02	U	F,C,P	8
6	Understand the basic commands to learn CNC Programming and Machining	PO1,PO5/ PS02	U	C,P	6

BMEE – 0900: PRODUCT DESIGN & DEVELOPMENT

Prerequisites: The knowledge of engineering drawing and to understand, ability to read technical drawing.

Objectives: To learn the sketcher workbench, part modeling and designing, wireframe and Surfacing for designing, assembly designing, & Drafting workbench.

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Part Modeling - Introductions to 3D Experience Software, File Management, Rotate, Zoom, Fit, Refresh, Delete, Undo, Redo Shaded View, Wire frame, Toolbar, sketching tool- line, profile, arc, centerline, Rectangle, Spline, Ellipse, Conics, Trim, Fillet, symmetry, Offset, Break, Create & Modify Dimension, Fix, Horizontal, Vertical, Parallel, Perpendicular, coincidence, symmetric, Tangent, Collinear, concentric. Pad, Pocket, Edge Fillet, variable Radius Fillet, Tritangent Fillet, Face-Face Fillet, Chamfer, Edit Parameter, Edit Sketch, Delete, Isolate, Multi Pocket, MultiPad, Shaft, Groove, Hole Creating Points, Reference Lines, Reference, Planes, Rib, Slot, Stiffener, Combined Solid, Multisection Solid, and Multisection cut Models, Draft Shell, Thickness, Thread, Mirror, Scaling, Translate Bodies, Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, and User Pattern.	22
II	Wireframe & Surface Design - Circle, Splines, Helix, Corner, Connect Curve, Projection, and Intersection .Extrude, Revolved, Spherical, Cylindrical, Offset, Fill, Swept, Loft, Blend, Join, Split, Trim, Healing, Untrim, Disassemble, Boundary, Extract, Split, Thick Surface, Closed Surface, Sew. Assembly - Snap, Smart Move, Constraining, Joints- Pin, Prismatic, Cylindrical. Drafting: Generations of views, Auxiliary View, Sections view, Detail view, Partial View, Broken view, Create Dimension, Create note, Generating Layouts	18

Text Books:

- Catia v5 design fundamentals: a step by step guide by JaecheolKoh.

Reference Books:

- CATIA V5-6R2015 Basics: Sketcher Workbench, Part Modeling, Assembly Design, Drafting, Sheet Metal Design, and Surface Design, Create Space Independent Publishing Platform (September 13, 2015)

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the basic commands of sketcher Workbench.	PO1, PO7, PO6/ PSO1	U	F,C	8
2	Understand and analysis the part modeling and designing in CATIA.	PO1, PO6, PO7/ PSO1	U	C	6
3	Describe the various methods to learn wireframe and Surfacing for designing.	PO1, PO7/ PSO1	U	C,P	6
4	Develop the various part of assembly design and learn the respective commands.	PO1/ PSO1	Ap	C,P, D	8
5	Describe the various methods to learn Drafting workbench.	PO1, PO5/ PSO2	U	C,P	6
6	Develop the various part of conceptual designing and learn the respective commands.	PO1, PO5/ PSO2	Ap	F,C,P, D, S	6

BMEE – 0901: PRODUCT DESIGN & MANUFACTURING

Prerequisites: The knowledge of manufacturing & design processes. To understand, ability to read technical drawing and part modelling

Objectives: To learn parametric modelling, mechanism design & simulation, Sheetmetal Model Fundamentals, Creating Primary and secondary Sheetmetal Wall Features, Bending and Unbending Sheetmetal Models, Form features and modifying sheet metal models, the process of Sheetmetal Setup and Tools and Detail sheet metal design & Computer Aided Manufacturing

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Parametric Modeling: Introduction to parametric modeling, declaring user defined parameter, integrating user defined parameters with designed model, applying relation with parameters, Defining the law using algebraic equations, creating design table using current parameters, Importing the existing design table, Mirror, Scaling, Translate Bodies. Rotate Bodies, Symmetry, Rectangular Pattern, Circular Pattern, User Pattern. Sheet metal Design: Sheet metal Model Fundamentals, Creating Primary Sheet metal Wall Features, Creating Secondary Sheet metal Wall Features, Bending and Unbending Sheet Metal Models, Sheet metal Form Features, Modifying Sheet Metal Models, Sheet metal Setup and Tools, Detail sheet metal designs.	20
II	Manufacturing: Manufacturing Process Overview, Creating Manufacturing Models, Configuring Operations, Using Reference Models, Using Work Piece Models, Creating and Using NC Model Assemblies, Creating and Configuring a Work Center, Creating and Configuring Tools, Using Manufacturing Parameters. NC Sequencing: Creating Face Milling Sequences, Creating Volume Milling Sequences, Creating Profile Milling Sequences, Creating Straight Cut Surface Milling Sequences, Advanced Surface Milling Options, Creating Roughing and Re-roughing Sequences, Creating Finishing Sequences, Creating Hole making Sequences, Using the Process Manager, Creating and Post-Processing CL Data Files.	20

Text Books:

- Advanced CATIA V5 Workbook: Knowledge ware, by Richard Cozzens
- Computer Numerical Control Programming Basics by Steve Krar Arthur Gill

Reference Books:

- Manufacturing Technology - Vol. 1 by PN Rao
- Manufacturing Technology - Vol. 2 by PN Rao

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the basic commands to learn the advance part modeling.	PO1, PO7, PO6/PSO1	U	F,C	6
2	Analyze and understand the advance wire frame and surfacing	PO1,PO7/ PSO1	An	C,P,M,S	8
3	Develop the various to learn parametric modeling	PO1/ PSO1	U	F,C,P, D	6

4	Describe the various methods to learn Computer Aided Manufacturing (CAM)	PO1/ PS01	U	C,P	6
5	Understand the basic commands to learn integrated design and Manufacturing	PO1,PO5/ PS02	U	F,C,P	8
6	Understand the basic commands to learn CNC Programming and Machining	PO1,PO5/ PS02	U	C,P	6

BMEE 0902: INJECTION MOLD DESIGN

Prerequisites: The knowledge of molding and casting parameters and nomenclatures.

Objectives: To learn the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters, validate the design of mold design setup, analyzing part design for best gate location and analysis of mold flow, the plastic part design requirements, mold design and its various aspects, the procedure of mold design and its various parameters.

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Injection Mold Design: Plastic part design requirements and guidelines, Introduction to plastics material, Introduction to thermoplastic molding processes, Plastic part design principles - design for manufacturing, Design for Assembly, Introduction to mold design, Types of molds based on construction, Molding Undercuts-Part Ejection, Mold Venting.	20
II	Design of Feed system, Mold Cooling, Types of molds based on runner system, Mold Shrinkage, Mold Metals. Mold Design - Core, Cavity: Basic Mold Process, Prepare design models for the mold process	20

Text Books :

- Injection Mold Design Engineering 8/31/07 Edition, by David Kazmer, Hanser Publications
- Fundamentals of Plastic Mold Design – 24 Jul 2012, by S. K. Nayak (Author), P.C. Padhi (Author), Y. Hidayatullah (Author)
- CATIA V5R20 for Designers – 6 Jan 2010, by Prof. Sham Tickoo Purdue Univ. (Author)

Reference Books:

- Injection Molds for Beginners, by Rainer Dangel, Hanser Publications, Cincinnati
- The Complete Technology Book On Plastic Extrusion, Molding and Mold Designs Paperback – 2006, By Niir Board Of Consultants And Engineers (Author)

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand the plastic part design requirements, mold design and its various aspects	PO1, PO7, PO6/PSO1	U	F,C	6
2	Analyze the procedure of mold design.	PO1,PO7/PSO1	An	C,P,M,D S	8
3	Understand the various parameters of mold design.	PO1/ PSO1	U	F,C,P	6
4	To validate and analyze the design of mold design setup.	PO1/ PSO1	An	F,C,P, D	6
5	To do analysis of part design for best gate location and analysis of mold flow.	PO1,PO5/PSO2	An	F,C,P, S	6
6	Understand the white light 3D Scanning process for data processing analysis and modeling.	PO1,PO5/PSO2	U	C,P	8

BMEE – 0903: PRESS TOOL DESIGN-I

Prerequisites: The knowledge of certain forging and forming processes.

Objectives: To learn product analysis, Design of Blanking, Piercing, Progressive and compound dies & introduction to Press Tool, Die sets, Guidelines for Design of Press Tools.

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Product Analysis: Introduction to Simulate, Theoretical Foundations, Structural Mechanics. Simulation Models, Explore materials and material properties, Understand and use structural constraints, Understand and use structural loads, Meshing, Understand convergence, Run structural analyses, Explore results, Refining the Design, Analyze assemblies with Simulate, Shells, Idealizations, Thermal Analysis.	20
II	Press Tool Design: Introduction to Presses and Auxiliary components, Classification based on Power Source, Press Frame, Actuation of Slides, No. of Slides in action, Sheet metal forming process, Force requirement for Blanking and Piercing, Introduction to Press Tool, Die sets. Design of Blanking, Piercing, Progressive and compound dies, Guidelines for Design of Press Tools, Center of Pressure in Un-symmetrically Profiled Components, Analysis of Press Tool, Design of Bending, drawing and forming dies.	20

Text Books:

- Lal, Jagdish, "Hydraulic Machines", Metropolitan Book Co. Pvt. Ltd.
- Rajput, R K, "Hydraulic Machines", S. Chand & co Ltd.
- Kumar, D. S., "Hydraulic Machines", Khanna Publishers

Reference Books:

- Press Tools Design and Construction by P H JOSHI (Sheet-Metal)

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	To learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wall features.	PO1, P07, P06/ PSO1	U	F,C	8
2	To learn Bending and Unbending Sheet-metal Models, Form features and modifying sheet metal models.	PO1,P07/ PSO1	U	F,C,P	8
3	To learn the process of Sheet-metal Setup and tools and detail sheet metal designs.	PO1/ PSO1	U	C,P,D	8
4	Design of Blanking, Piercing, Progressive and compound dies.	PO1,P06, P07/ PSO1	Ap	F,C,P, D	6
5	Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools	PO1,P07/ PSO1	U	C,P,D	6
6	To learn rapid prototyping or additive manufacturing, RPT Data Processing, Data Post Processing, Solid based rapid manufacturing processes.	PO1,P05/ PSO2	U	C,P	6

BMEE – 0904: PRESS TOOL DESIGN-II

Prerequisites: The knowledge of engineering press tool design, pressing tools, processes and machines

Objectives: To make the students understand the concepts of prototyping with manufacturing by giving more emphasis to their applications in engineering.

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Rapid Proto typing: Introduction to Rapid Prototyping, Design for modularity, Data Preparation, FDM manufacturing processes, RPT Data Processing, Data Post Processing, 3D Printing.	20
II	Press Tool Manufacturing: 300 Ton Press Deep Draw Press, Co2 Welding Machine, Spot Welding Machine, Press Tool Machining, Press Component Manufacturing, Assembly	20

Text Books :

- Lal, Jagdish, "Hydraulic Machines", Metropolitan Book Co. Pvt. Ltd.
- Rajput, R K, "Hydraulic Machines", S. Chand & co Ltd.
- Kumar, D. S., "Hydraulic Machines", Khanna Publishers

Reference Books:

- Press Tools Design and Construction by P H JOSHI (Sheet-Metal)

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	Understand and learn Sheet-metal model fundamentals, creating primary and secondary sheet-metal wall Features	PO1, PO7, PO6/PSO1	U	F,C	8
2	Analyze and learn Bending and Unbending Sheet-metal Models, Form features and modifyingsheet metal models.	PO1,PO7/ PSO1	An	F,C,P,D	8
3	Understand and learn the process of Sheet-metal Setup and Tools and Detail sheet metal designs	PO1/ PSO1	U	C,P,D	6
4	Student will be able to do designing of blanking & Piercing processes and progressive & compound dies.	PO1,PO6, PO7/PSO1	Ap	F,C,P, D	8
5	Introduction to Press Tool, Die sets, Guidelines for Design of Press Tools	PO1,PO7/ PSO1	U	C,P,D	6
6	To learn rapid prototyping or additive manufacturing, RPT Data Processing, Data Post Processing, Solid based rapid manufacturing processes.	PO1,PO5/ PSO2	U	C,P	6

BMEE – 0905: SMART MANUFACTURING

Prerequisites: The knowledge of basic electronic engineering components circuits and C language.

Objectives: To learn the concepts of IOT, identify the different technology, different applications in IOT, different applications in IOT, different protocols used in IOT & Predictive Maintenance.

Credits: 04

L-T-P: 4:0:0

Module No.	Contents	Teaching Hours (Approx.)
I	Basics of IOT: What is IOT? Network Architecture, Device Architecture, what is Embedded? Basic Hardware in IOT: Basic Electronics Components of IOT, LED, Resistors, Capacitors, Transistors, Relay, Switch, Buzzer, LDR, Potentiometer, PIR, how to glow LED without program, LED by switch, LED by two switch. Controller use in IOT: What is Arduino & ESP8266? History of Arduino & ESP8266, Hardware and Software Description, Fundamentals, Basic Arduino Programs, Serial Monitor and Debugging Tool, Installing Board Packages, Installing Sensor Libraries, Interfacing Sensors.	22
II	Tinker cad Simulation: Basic Electronic Circuits, Arduino Simulation. Augmented reality: Introduction to AR, The Basics of AR functionality, Taking the next steps with ARCore, Bringing ARCore to life, Frameworks of Software Development Tools in VR. IOT Communication Protocols: Wireless Protocols (SPI, I2C, UART, USRT), Networking Protocols (OSI Reference Model, TCP/IP, Ethernet), Sending data to Thingsboard.io/Adafruit. Preventive Maintenance: Maintenance Method Selection, Function and components, Failure Modes, Maintenance method and essential care tasks. Thingworx Composer: Introduction to Thingworx, Creating Thing, Thing Template, Building Mashups, Creating Weather mashup	18

Text Books:

- The Internet of Things (MIT Press Essential Knowledge series) ,by Samuel Greengard (Author)
- IOT (Internet of Things) Programming: A Simple and Fast Way of Learning IOT ,by David Etter (Author)

Reference Books:

- Arduino for Beginners: Step-by-Step Guide to Arduino, by Author Simon Knight
- Beginning c for Arduino, by Jack Purdam
- Things Worx third edition, by Gerardus Blokduk

Focus: This course focuses on Employability/Skill development and aligned with CO's 1 and 2

Outcomes: After studying these topics, the student will be able to

CO	CO Statement	PO/PSO	CL	KC	Duration
1	To learn the concepts of IOT and its application in Manufacturing Industry.	PO1, PO7, PO6/PSO1	U	F,C	8
2	To learn different protocols used in IOT.	PO1,PO7/ PSO1	U	C	8
3	To learn about different sensors and its data collection in IoT platform.	PO1/ PSO1	U	F, C	6
4	To learn about different controllers in IoT and its use.	PO1,PO6, PO7/PSO1	U	F,C	8
5	To learn ThingWorx IIoT platform and use it with real-time projects.	PO1,PO7/ PSO1	Ap	F,C,P,D	6
6	To learn about Predictive maintenance & asset monitoring using IoT	PO1,PO5/ PSO2	U	C,P	6