Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

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Proposed Course Contents for

B. Tech. in Production Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities

and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of production engineering including manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate production systems and processes considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer based methods and tools to develop production systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam

B. Tech. Production Engineering

Course Structure for Semester VII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTMEC701	PCC 29	Mechatronics	2	1	--	20	20	60	100	3
BTPRC702	PCC 30	Tool Design	2	1	--	20	20	60	100	3
BTPRC703	PCC 31	Hydraulic, Pneumatic and Fluidic Control	2	1	--	20	20	60	100	3
BTPRC704A	PEC 2	Additive Manufacturing	2	1	--	20	20	60	100	3
BTPRC704B		Engineering Tribology								
BTMEC704C		Finite Element Method								
BTMEC704D		Surface Engineering								
BTAMC704C		Automobile Design (Product Design, PLM, CAE, Catia)								
BTMEC705A	OEC 5	Engineering Economics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTMEC705B		Intellectual Property Rights								
BTMEC705C		Wind Energy								
BTMEC705D		Knowledge Management								
BTPRL706	PCC 32	Mechatronics Lab	--	--	2	30	--	20	50	1
BTPRL707	PCC 33	Tool Design Practice	--	--	2	30	--	20	50	1
BTPRS708	Project 4	Seminar	--	--	2	30	--	20	50	1
BTPRF709	Project 5	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1
BTPRP710	Project 6	Project Stage-I**	--	--	6	30	--	20	50	3
		Total	11	4	12	200	80	370	650	19

***In case of students opting for Internship in the eighth semester, the Project must be industry-based*

B. Tech. Production Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
Choose any two subjects from ANNEXURE-A#			-	-	--	20	20	60	100	3
			-	-	--	20	20	60	100	3
BTPRP803	Project 7	Project Stage-II or Internship and Project*	--	--	30	50	--	100	150	15
		Total	--	--	30	90	40	220	350	21

** Six months of Internship in the industry*

[#] These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

 # Students doing project in the Institute will have to appear for CA/MSE/ESE

ANNEXURE-A#
Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	BTMEC801A	Fundamentals of Automotive Systems	12 Weeks	IITM	Prof. C. S. Shankar Ram
2	BTMEC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTMEC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTMEC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S
5	BTMEC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan
6	BTMEC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

Semester VII

Mechatronics

BTMEC701	PCC 29	Mechatronics	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Objectives: To understand fundamental principles of Mechatronics system, various components involved and their application, reinforce analytical skills and use them in analyzing and designing mechatronic systems. To develop an approach required to analyze and solve control problems with understanding of data and signal transfer among various sub-systems.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify and select different sensors and transducers for a particular application.
CO2	Categorize the signal conditioning and data representation techniques.
CO3	Design pneumatic and hydraulic circuits for a given application.
CO4	Write a PLC program using Ladder logic for a given application.
CO5	Identify the applications of microprocessor and micro controller.
CO6	Compare PI, PD and PID controllers and select suitable controller for a given application.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1
CO2	3	2			3	3	2				1	3
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			
CO5	3			1	3	2	3					2
CO6		3	3		3	3	1	1	3			2

Course Contents:

Unit 1: Introduction

Introduction to Mechatronics systems, elements, advantages;p ractical examples of Mechatronics systems.

Sensors and Transducers: Various types of sensors and transducers used in Mechatronics system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor,

tactile sensors, Selection of sensors.

Unit 2: Signal Conditioning and Data Representation

Types of electronic signals, Need for signal processing, Operational amplifiers: Types, classification and applications, Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electro-magnetic Relays, Data representation systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3: Drives

Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.

Pneumatics and Hydraulics: Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods.

Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4: Microprocessor and Microcontroller

8085 microprocessor: architecture, various types of registers and their functions in 8085µP, Instruction sets, interfacing, applications. 8081 microcontroller: architecture, Instruction sets, various pins and their functions interfacing, applications.

Programmable Logic Controller: Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection of PLCs, Programming: Ladder logic and FBD

Unit 5: Control Systems

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using Spring, Dashpot and Mass equivalence.

Unit 6: Stability of Systems

On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts/References:

1. HMT Limited, “Mechatronics”, Tata McGraw Hill Publications, 1998.
2. W. Bolton, “Mechatronics; Electronic Control System in Mechanical Engineering”, Pearson Education Asia, 1999.
3. Raven, “Automatic Control Engineering”, Tata McGraw Hill Publications, New York, 1986.

Tool Design

BTPRC702	PCC 30	Tool Design	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Objectives: To understand tool configuration, it's functioning and wear characteristics, Tool materials and developments, application. To understand orthogonal cutting process and forces involved in the cutting. To evolve design of jigs and fixtures for the effective use of machining processes.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify ASA and ORS systems of tool geometry.
CO2	Classify the geometry of single point and multi point cutting tool
CO3	Apply principles of locating and clamping systems, and Design jig and fixture for conventional and NC machining
CO4	Select and design progressive, compound or combination dies for press working operations
CO5	Select and design drawing, and bending dies.
CO6	Categorize forging operations with single and multi-impression dies

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1			1							1
CO2		1										1
CO3	2	2	2		1							
CO4	1	2	1	1	2		1					2
CO5		2	1		2							2
CO6	1	2	1		1				1			1

Course Contents:

Unit 1: Design of Single Point Cutting Tools

Introduction, designation of cutting tools, ORS and ASA system, Importance of tool angles, design of chip breakers , machining forces and merchant's circle diagram. Taylor's tool life equation.

Unit 2: Design of Multipoint Cutting Tools

Drill: Nomenclature, design of drill, moment, thrust force and power required. Milling Cutters: Nomenclature, design of milling cutter, power required for milling. Broaches: Nomenclature, design of broach, broaching power, length of toothed portion.

Unit 3: Design of Jigs and Fixtures

Twelve degree of freedom, 3-2-1, 4-2-1 method of location, Redundancy, fool proofing, locating & clamping**:** locating devices, clamping devices, Quick acting devices, drill bushes, Drilling jigs**:** need, design principles, types of drilling jigs. Milling fixtures**:** essential features of a milling fixtures, types, Indexing of Jigs and Fixtures.

Unit 4: Press Tool Design

Press working equipment, press selection, types of dies, clearance, angular clearance, stripper plate, cutting forces , method of reducing cutting forces , die block design, punch , punch design , methods of holding punch, centre of pressure, scrap strip layout. Blanking die design, piercing die design, design of progressive dies.

Unit 5: Bending and Drawing Dies

Bending Dies: v-bending, bending forces, bend allowance, spring back and its prevention, design principles.

Drawing Dies: introduction , difference between bending , and drawing , metal flow during drawing, design consideration: radius of draw die, punch radius, draw clearance, drawing speed, calculation of blank size, number of draws, drawing pressure, blank hold pressure.

Unit 6: Forging Die Design and Mould Design

Forging dies, single impression dies, multiple impression dies,

Forging design factors: draft, fillet and corner radius, parting line, shrinkage and die wear, mismatch, finish allowances, webs and ribs.

Die design for drop forging and press forging: preliminary forging operation, fullering, edging, bending, flattering, blocking, finishing, cutoff, die block dimensions. Determination of stock size in closed and open die forging

Mould design: injection mould, mould base, design of simple two plate injection moulds, mould materials.

Texts:

1. P.C.Sharma, "A Text Book of Production Engineering", S. Chand & company ltd., New Delhi, 2001.
2. P.H.Joshi, "Jigs & Fixtures", Tata McGraw Hill Publishing Co. New Delhi,2001.
3. M.H.A. Kempster, "Introduction of Jigs and Fixtures design", The English Language Book Society and Hodder and Stoughton, London, 3rd edition, 1982.

References:

1. Geoffery Boothroyd, Winston Knight, "Fundamentals of Machining and Machine Tools", Taylors and Francis, 3rd edition, 2006.
2. E. G. Hoffman, "Jigs and Fixtures", 5th Cengage Learning, 2004.

Hydraulic, Pneumatic and Fluidic Control

BTPRC703	PCC 31	Hydraulic, Pneumatic and Fluidic Control	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites:

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the type of control system and their utility
CO2	Describe the hydraulic power generation
CO3	Design pneumatic and hydraulic circuits for a given application
CO4	Discuss steady state operating forces, transient forces and valve instability
CO5	Design of pure fluid digital elements, Lumped and distributed parameter fluid systems

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2				1	1						
CO3	2	2		3	3							
CO4	2					2	3			2		1
CO5	2	2		2	3							

Course Contents:

Unit I

Introduction to control system, types of control system and their utility.

Unit II

Hydraulic power generation and transmission, valve control pressure flow relationship and constructions.

Unit III

Steady state operating forces, transient forces and valve instability.

Unit IV

Circuit design, pneumatic valves, hydraulic and pneumatic drives, introduction to fluidic devices and sensors.

Unit V

Lumped and distributed parameter fluid systems, fluid mechanics of jets, wall attachment and vortex devices.

Unit VI

Pure fluidic analog amplifiers, analog signal control techniques, design of pure fluid digital elements.

Texts / References:

1. J.F.Blackburn, G.Rechthof, J.L. Shearer, Fluid Power Control, MIT.
2. B.W.Anderson,The Analysis and Design of Pneumatic Systems, Wiley.
3. K.Foster, G.Parker, Fluidic Components and Circuits, Wiley.
4. A.B.Goodwin, Fluid Power Systems, Macmillan.

Additive Manufacturing

BTPRC704A	PEC 2	Additive Manufacturing	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Objectives: To classify the different AM processes, design for AM processes, future scope.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Summarize the importance of Additive Manufacturing.
CO2	Classify the different AM processes
CO3	Design for AM processes
CO4	Identify and outline the applications of AM
CO5	Differentiate the post processing processes.
CO6	Compare consequences of using thermal and non-thermal processes.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2					1
CO2	2	2	3	3	3	3	1					1
CO3	2	2	3	3	3		2					1
CO4	3	3	3	2	2	2	2					1

CO5	2	3	3	2	2	2	2					1

Course Contents:

Unit 1: Introduction to Additive Manufacturing
Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM
AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing.
Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, solid sheet system.

Unit 2: Design for AM
Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

Unit 3: Guidelines for process selection
Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

Unit 4: AM Applications
Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defence, automobile, Bio-medical and general engineering industries

Unit 5: Post processing of AM parts
Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Unit 6: Future Directions of AM
Introduction, new types of products and employment and digiproneurship.

Texts/References:

1. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2003.
2. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
3. Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer, 2001.

Engineering Tribology

BTPRC704B	PEC 2	Engineering Tribology	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic concepts and importance of tribology.
CO2	Evaluatethenatureofengineeringsurfaces,theirtopographyandsurface characterization techniques
CO3	Analyze the basic theories of friction and frictional behavior of various materials
CO4	Select a suitable lubricant for a specific application
CO5	Compare different wear mechanisms
CO6	Suggest suitable material combination for tribological design.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2	1	2	2		1						
CO3	2	3	1	2	1	1	1					
CO4	2	2	2		1	1	2		1		1	
CO5	1	1	1	1	1							
CO6	2	2	2		2	2	2		1	1	1	

Course Contents:

Unit 1: Introduction
Definition of tribology, friction, wear and lubrication; importance of the tribological studies.
Surface Topography: Methods of assessment, measurement of surface roughness- different statistical parameters (R_a, R_z, R_{max}, etc.), contact between surfaces, deformation between single and multiple asperity contact, contact theories involved

Unit 2: Friction
Coulomb and Amontons laws of friction, its applicability and limitations, comparison between static, rolling and kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

Unit 3: Lubrication

Types of lubrication, viscosity, characteristics of fluids as lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed, boundary lubrication, various additives, solid lubrication.

Unit 4: Wear

Sliding wear: Abrasion, adhesion and galling, testing methods pin-on-disc, block-on-ring, etc., theory of sliding wear, un-lubricated wear of metals, lubricated wear of metals, fretting wear of metals, wear of ceramics and polymers.

Wearing by plastic deformation and brittle fracture. Wear by hard particles: Two-body abrasive wear, three-body abrasive wear, erosion, effects of hardness shape and size of particles.

Unit 5: Wear and Design

Introduction, estimation of wear rates, the systems approach, reducing wear by changing the operating variables, effect of lubrication on sliding wear, selection of materials and surface engineering. Principles and applications of tribo design.

Unit 6: Materials for Bearings

Introduction, Rolling bearings, Fluid film lubricated bearings, marginally lubricated and dry bearings, gas bearings.

Texts:

1. I. M. Hutchings, "Tribology, Friction and Wear Engineering Materials", Edward Arnold, London.
2. R. C. Gunther, "Lubrication", Baily Brothers and Swinfen Limited.
3. F. T. Barwell, "Bearing Systems, Principles and Practice", Oxford University Press.

References:

1. B. C. Majumdar, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Private Limited, Allahabad.
2. D. F. Dudley, "Theory and Practice of Lubrication for Engineers", John Willey and Sons.
3. J. Halling, "Principles of Tribology", McMillan Press Limited.
4. Cameron Alas Tair, "Basic Lubrication Theory", Wiley Eastern Limited.
5. M. J. Neale, "Tribology Handbook", Butterworth's.

D. D. Fuller, "Lubrication".

Finite Element Method

BTMEC704C	PEC 2	Finite Element Method	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural , thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two and three dimensional problems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				1		1	1
CO2	2	3	2	1	2	1		1			2	1
CO3	3	2	2	1	1				1		2	1
CO4	3	3	2	1	2		1		1		2	1
CO5	3	1	1		1		1				2	1
CO6	1	1	1						1		1	1

Course Contents:

Unit 1: Introduction
Finite element analysis and its need, Advantages and limitations of finite element analysis (FEA), FEA procedure.

Unit 2: Elements of Elasticity
Stress at a point, Stress equation of equilibrium, 2-D state of stress, Strains and displacements, Stress-strain relationship for 2-D state of stress, Plane stress and plane strain approach.

Unit 3: Relevant Matrix Algebra
Addition, subtraction and multiplication of matrices, Differentiation and integration of matrices, Inverse of a matrix, Eigen values and eigen vectors, Positive definite matrix, Gauss elimination.

Unit 4: One-Dimensional Problems
Introduction, FE modeling, Bar element, Shape functions, Potential energy approach, Global

stiffness matrix, Boundary conditions and their treatments, Examples.

Unit 5: Trusses and Frames
Introduction, Plane trusses, Element stiffness matrix, Stress calculations, Plane frames, examples.

Unit 6: Two-dimensional Problems
Introduction and scope of 2-D FEA, FE modeling of 2-D problem, Constant strain triangle, other finite elements (no mathematical treatment included), Boundary conditions.

Texts:

1. T. R. Chandrupatla, A.D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.
2. P. Seshu, "A Textbook of Finite Element Analysis", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc.

References:

1. K. J. Bathe, "Finite Element Procedures", Prentice Hall of India Pvt. Ltd., 2006.

Surface Engineering

BTMEC704D	PEC 2	Surface Engineering	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Learn the importance and need of surface engineering
CO2	Describe various surface cleaning and modification techniques
CO3	Understand the concepts of surface integrity
CO4	Compare various surface coating technologies
CO5	Select appropriate method of coating for a given application
CO6	Apply measurement techniques and carry out characterization of coated surfaces.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1							1		1
CO2	2				2							
CO3	2	2	1	2						1		
CO4	2				1	1		1		1		

CO5	2	2	1		1		1	1	1	1	1	
CO6	2	2	1	2	2			1	1	1		

Course Contents:

Unit 1: Introduction
Definition, Significance, Role of surface Engineering in creating high performance product, Functional characteristics of a surface, Nature of surfaces: Deformed layer, Beilby layer, chemically reacted layer, Physisorbed layer, Chemisorbed layer; Classification of Surface Engineering Techniques.

Unit 2: Surface Preparation Techniques
Factors affecting selection of cleaning process, Significance of surface preparation, Classification of cleaning processes, Chemical cleaning processes; Mechanical Processes; Substrate considerations, Surface contaminants or soils, Tests for cleanliness.

Unit 3: Surface Integrity
Definition, Importance, Surface alterations, Factors in Surface Integrity: Visual, Dimensional, Residual stress, Tribological, Metallurgical; Measuring Surface Integrity effects: Minimum and Standard data set, Macroscopic and microscopic examination.

Unit 4: Surface Modification Techniques
Classification, Thermal treatments: Laser and electron beam hardening, Mechanical treatments: Short peening: Peening action, surface coverage and peening intensity, Types and sizes of media, Control of process variables, equipment;
Ion Implantation: Basic Principle, Advantages and disadvantages, equipment.

Unit 5: Surface Coating Techniques
Thermal Spraying: Types and applications; Chemical Vapour Deposition: Principles, Reactions, Types and applications; Physical Vapour Deposition: Basic principle, Evaporation, Sputtering, Ion Plating, Applications; Electroplating: Principle of working and applications; Types of Coatings: Hard, Soft, Single layer, Multi-layer.

Unit 6: Characterization of Coatings
Physical characteristics and their measurements: Coating thickness, Surface Morphology and Microstructure. Mechanical properties and their Measurements: Hardness, Adhesion, Friction and Wear.

References:

1. ASM Handbook, “Volume 5: Surface Engineering”, ASM International.
2. K. G. Budinski, “Surface Engineering for Wear Resistance”, Prentice Hall.
3. T. Burakowski, T. Wierschon, “Surface Engineering of Metals: Principles, Equipment, Technologies”, CRC Press.
4. B. Bhushan, B. K. Gupta, “Handbook of Tribology: Materials, Coatings, and Surface Treatments”, Tata McGraw Hill Publications.
5. ASM Handbook, “Volume 16: Machining”, ASM International.

Automobile Design (Product Design, PLM, CAE, Catia)

BTAMC704C	PEC 2	Automobile Design (Product Design, PLM, CAE, Catia)	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Domain related training (Approx. 20 Hrs)

Unit 1:

Introduction to Styling, Basic of Design - Introduction to Design, Good Design & it's Examples of All Time, Industrial Design & its use. Design Process - Typical Product Life Cycle, Automotive Design Process (for production release), Design Studio (Automotive studio) Process or Product Conceptualization Process, Case Study. CAS Surfaces or Digital Clay Models, Class A Surfaces - Role of Class A surface Engineer, Requirements for a Surface to fulfill " Class A Surface" Standards, Case Studies for Class A Surfaces, Class A Surface Creation for Bonnet

Unit 2:

Introduction to Body In White: Introduction & familiarization to Body In White (BIW), various type of BIW, Types of BIW sub system, various aggregates of BIW. Bonnet Design Case Study: Function of Bonnet, Defined Input to Bonnet, Intended Input to Bonnet Design. Steps in Bonnet design, Study of Class A Surfaces, Hood Package Layout , Typical Sections, Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D, Hood Structural Members, CAE 1(Durability, Crash), Panel Detail Design, Body Assembly Process, CAE 2(Durability, crash,

individual panel level), Design Updating & Detailing Prototypes, Design Updating & Production Release

Unit 3:
Introduction to CAE & its importance in the PLM, Introduction to FEA & its applications (NVH, Durability & Vehicle Crashworthiness). Introduction of Pre-Processor, Post-Processor & Solvers. Importance of discretization & Stiffness Matrix (for automobile components). Importance of oil canning on an automobile hood with Case study related to Durability Domain. Modal analysis on the hood (Case Study related to NVH Domain). Introduction of vehicle crashworthiness & Bio-mechanics (Newtonian laws, energy management, emphasis of impulse in car crashes). Head impact analysis as a Case study on the hood of an automobile (EuroNCAP test regulation). Importance of Head performance criteria (HPC). Introduction to failure criteria (By explaining the analogy of using uni-axial test results for predicting tri-axial results in reality), Mohr's Circle, Von-Mises stress criteria, application of various failure criteria on brittle or ductile materials

Unit 4:
Introduction to CAD,CAM & CAE, FEA - Definition, Various Domains – NVH, Dura, Crash, Occupant Safety, CFD. Implicit vs. Explicit Solvers, Degree of Freedom, Stiffness Matrix, Pre-Post & Solver; Types of solvers, Animation. Durability - Oil Canning, Oil Canning on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. NVH – Constrained Modal Analysis, Constrained Modal Analysis on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. Crash – Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria, Von-Mises Stress

Unit 5:
Sheet metal design & Manufacturing Cycle, Simultaneous Engineering (SE) feasibility study, Auto Body & its parts, Important constituents of an automobile, sheet metal, sheet metal processes. Type of draw dies, Draw Model development & its considerations. Forming Simulations, Material Properties, Forming Limit Curve (FLD), Pre Processing, Post-Processing, Sheet metal formability- Simulation

Unit 6:
Die Design – Sheet metal parts, Sheet metal operations (Cutting, Non-Cutting etc.), Presses, Various elements used in die design, Function of each elements with pictures, Types of dies, Animation describing the working of dies, Real life examples of die design. **Fixture Design -** Welding (Spot/Arc Welding), Body Coordinates, 3-2-1 principle, Need for fixture, Design considerations, Use of product GD&T in the fixture design, fixture elements. Typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Typical unit design for sheet metal parts (Rest/Clamp/Location/Slide/Dump units/Base), Types of fixture (Spot welding/ Arc welding/ Inspection fixture/Gauges)

Tools related training (Approx. 20 Hrs):
Depending on the tools available in the college, the relevant tool related training modules shall be enabled to the students.
AutoCAD, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD P&ID, Autodesk 3ds Max, Autodesk Alias, Autodesk SketchBook, Automotive, CATIA V5, CATIA V6, FEA, Autodesk Fusion 360, Autodesk Inventor, Autodesk Navisworks, Autodesk Ravit,

Autodesk Showcase, Autodesk Simulation, PTC Creo, PTC ProENGINEER, Solid Edge, SOLIDWORKS.

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.
4. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.

References:

1. IbrahimZeid,"CAD/CAM TheoryandPractice", TataMcGrawHillPublication,
2. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
3. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
4. Onwubiko, C., "Foundation of Computer Aided Design", West Publishing Company. 1989
5. R.W.Heine, C. R.Loper and P.C.Rosenthal, *Principles of Metal Casting*, McGraw Hill, Newyork, 1976.
6. J. H.Dubois And W. I.Pribble, *Plastics Mold Engineering Handbook*, Van NostrandReihnhold, New York, 1987.
7. N. K. Mehta, Machine tool design, Tata Mcgraw-hill, New Delhi, 1989.
8. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
9. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
10. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
11. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, SpringerVerlag, 2004. ISBN 1852338105

Engineering Economics

BTMEC705A	OEC 5	Engineering Economics	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, Benefit-cost

	ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Compute the depreciation of an asset using standard Depreciation techniques to assess its impact on present or future value.
CO5	Apply all mathematical approach models covered in solving engineering economics problems: mathematical formulas, interest factors from tables, Excel functions and graphs. Estimate reasonableness of the results.
CO6	Examine and evaluate probabilistic risk assessment methods.
CO7	Compare the differences in economic analysis between the private and public sectors. Recognize the limits of mathematical models for factors hard to quantify.
CO8	Develop and demonstrate teamwork, project management, and professional communications skills

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											3	
CO2											3	
CO3											3	
CO4											3	
CO5					3						3	
CO6											3	
CO7											3	
CO8									2		3	

Course Contents:

Unit 1: Introduction to Economics

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of En**g**ineering Economics: Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis: V ratio, Elementary economic Analysis: Material selection for product Design selection for a product, Process planning.

Unit 2: Value Engineering

Make or buy decision, Value engineering: Function, aims, and Value engineering procedure. Interest formulae and their applications: Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor: equal payment series capital recovery factor:

Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

Unit 3: Cash Flow

Methods of comparison of alternatives: present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

Unit 4: Replacement and Maintenance Analysis
Replacement and Maintenance analysis: Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset: capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit 5: Depreciation
Depreciation: Introduction, Straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, service output method of depreciation-

Unit 6: Evaluation of Public Alternatives
Introduction, Examples, Inflation adjusted decisions: procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Texts:
1. PanneerSelvam R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

References:
1. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, "Engineering Economics and analysis", Engineering Press, Texas, 2010.
3. E. P. Degarmo, W. G. Sullivan and J. R. Canada, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A. Khan, "Engineering Economy", Dorling Kindersley, 2012.

Intellectual Property Rights

BTMEC705B	OEC 5	Intellectual Property Rights	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic fundamental terms such as copyrights, Patents, Trademarks etc.,
CO2	Interpret Laws of copy-rights, Patents, Trademarks and various IP registration Processes.
CO3	Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms commercial strategies.
CO4	Create awareness at all levels (research and innovation) to develop patentable

	technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2								1				
CO3		1						1				
CO4										1		
CO5	1							1				
CO6								2				

Course Contents:

Unit 1: Introduction to Intellectual Property
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit 2: Trade Marks
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 3: Law of Copy Rights
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Unit 4: Law of Patents
Foundation of patent law, patent searching process, ownership rights and transfer.

Unit 5: Trade Secrets
Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

Unit 6: New Development of Intellectual Property
New developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international trade mark law, copy right law, international patent law, and international development in trade secrets law.

Texts:
1. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage learning.
2. Prabuddha Ganguli, "Intellectual property right: Unleashing the knowledge economy", Tata McGraw Hill Publishing Company Ltd.

References:

1. Ajit Parulekar, Sarita D'Souza, "Indian Patents Law-Legal and Business implications", Macmillan India Ltd., 2006.
2. B. L. Wadhera, "Law related to patents, Trademarks, Copyrights, Designs and Geographical indications", Universal law Publishing Pvt. Ltd., India, 2000.
3. P. Narayanan, "Law of copyright and Industrial Designs", Eastern Law house, Delhi, 2010.

Wind Energy

BTMEC705C	OEC 5	Wind Energy	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand historical applications of wind energy
CO2	Understand and explain wind measurements and wind data
CO3	Determine Wind Turbine Power, Energy and Torque
CO4	Understand and explain Wind Turbine Connected to the Electrical Network AC and DC
CO5	Understand economics of wind energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2	2	2	1		1
CO2		3	2	1	3	2	2	2	2			1
CO3	3	3	1	1	2	2	1					1
CO4	3	3		1								1
CO5	3	2	1									1

Course Contents:

Unit 1: Introduction
Historical uses of wind, History of wind electric generations

Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull statistics, Weibull parameters, Rayleigh and normal distribution

Unit 2: Wind Measurements
Biological indicators, Rotational anemometers, other anemometers, Wind direction

Unit 3: Wind Turbine Power, Energy and Torque
Power output from an ideal turbine, Aerodynamics, Power output from practical turbines,

Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.

Unit 4: Wind Turbine Connected to the Electrical Network
Methods of generating synchronous power, AC circuits, The synchronous generator, Per unit calculations, The induction machine, Motor starting, Capacity credit features of electrical network

Unit 5: Wind Turbines with Asynchronous Electric Generators
Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self excitation of the induction generators, Single phase operation the induction generator, Field modulated generators, Roesel generator.
Asynchronous Load: Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.

Unit 6: Economics of Wind Systems
Capital costs, Economic concepts, Revenues requirements, Value of wind generated electricity

Texts:
1. S. Ahmad, "Wind Energy: Theory and Practice", Prentice Hall of India Pvt. Ltd.

References:
1. Garg L. Johnson, "Wind Energy Systems" Prentice Hall Inc., New Jersey, 1985.
2. Desire Le Gouriers, "Wind Power Plants: Theory and Design" Pergamon Press, 1982.

Knowledge Management

BTMEC705D	OEC 5	Knowledge Management	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
CO2	Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.
CO3	Identify and select tools and techniques of KM for the stages of creation, acquisition, transfer and management of knowledge.
CO4	Analyze and evaluate tangible and intangible knowledge assets and understand current KM issues and initiatives.
CO5	Evaluate the impact of technology including telecommunications, networks, and internet/intranet role in managing knowledge.
CO6	Identify KM in specific environments: managerial and decision making

	communities; finance and economic sectors; legal information systems; health information systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1						3
CO2												3
CO3												3
CO4								2				3
CO5					3				2			3
CO6												3

Course Contents:

Unit 1: Introduction
Definition, evolution, need, drivers, scope, approaches in Organizations, strategies in organizations, components and functions, understanding knowledge.

Unit 2: Learning Organization
Five components of learning organization, knowledge sources and documentation.

Unit 3: Essentials of Knowledge Management
Knowledge creation process, knowledge management techniques, systems and tools.

Unit 4: Organizational Knowledge Management
Architecture and implementation strategies, building the knowledge corporation and implementing knowledge management in organization.

Unit 5: Knowledge Management System
Knowledge management system life cycle, managing knowledge workers, knowledge audit, and knowledge management practices in organizations, few case studies.

Unit 6: Futuristic KM
Knowledge engineering, Theory of computation, data structure.

Texts:

1. Thohothathri Raman, "Knowledge Management: A resource book", Excel, 2004.
2. M. Elias, Awad Hasan, M. Ghazri, "Knowledge Management", Pearson Education.

References:

1. Amrit Tiwana, "Strategy &Knowledge Platforms", The KM Toolkit–Orchestrating IT, Pearson, PHI, 2nd edition.
2. Peter Senge et al., "The Fifth Discipline Field Book–Strategies and Tools for Building A learning Organization", Nicholas Brealey, 1994.
3. Sudhir Warier, "Knowledge Management", Vikas Publications.
4. Madanmohan Rao, "Leading with Knowledge", Tata McGraw Hill Publications.

Mechatronics Lab

BTPRL706	PCC 32	Mechatronics Lab	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: Mechatronics

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the various types of sensors and their applications
CO2	Design a pneumatic circuit for a given application
CO3	Design a hydraulic circuit for a given application
CO4	Write a PLC program using Ladder logic
CO5	Experiment PID controller for controlling temperature
CO6	Demonstrate the capacitance sensor for measuring level

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2							3			1
CO2	1	1	3	3	3		3		3			1
CO3	1	1	3	3	3		3		3			1
CO4	2		3	1	3		1		3			1
CO5	1	1	3	3	3	3	2		3			1
CO6	1	1	3	3	2		2		3			1

List of Practicals/Experiments/Assignments

1. Study and demonstration of various types of sensors
2. Speed control of various types of Electrical Motors
3. Minimum two circuits on Pneumatics to be developed on Pneumatic trainer kit
4. Minimum two circuits on Electro-Pneumatics to be developed on Electro- Pneumatic trainer kit
5. Minimum two circuits on Hydraulics and Electro-hydraulics to be developed on Hydraulic trainer kit
6. Programming of Microprocessor and Microcontroller
7. Programming on PLC
8. Demonstration of Process control such as temperature, level, flow, etc. control using PID controller

Tool Design Practice

BTPRL707	PCC 33	Tool Design Practice	0-0-2	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Objectives: To understand tool configuration, it's functioning and wear characteristics, Tool materials and developments, application. To understand orthogonal cutting process and forces involved in the cutting. To evolve design of jigs and fixtures for the effective use of machining processes.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify ASA and ORS systems of tool geometry.
CO2	Classify the geometry of single point and multi point cutting tool
CO3	Apply principles of locating and clamping systems, and Design jig and fixture for conventional and NC machining
CO4	Select and design progressive, compound or combination dies for press working operations
CO5	Select and design drawing, and bending dies.
CO6	Categorize forging operations with single and multi-impression dies

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1		1			1							1
CO2		1										1
CO3	2	2	2		1							
CO4	1	2	1	1	2		1					2
CO5		2	1		2							2
CO6	1	2	1		1				1			1

List of Practicals/Experiments/Assignments

Any Eight Experiments/Assignment should be performed/demonstrated.

1. Drawing and Design of Single Point Tool.
2. Design of Drill Jig (Assembly & Bill of Material)
3. Design of Milling Fixture (Assembly & Bill of Material)
4. Design and Drawing of two Drilling / Reaming jigs. (Details of at least one Sheet showing Manufacturing Drawing with Tolerances, Material Specification and Heat Treatment)
5. Design of Broach.

6. Design Multi impression forging Die.
7. Design of Press Tool.
8. Design Bending and Drawing Dies.
9. Design of Simple Two Plate Injection Moulds.
10. Assignments based on the Topics Covered in the Theory Course.

Seminar

BTPRS708	Project 4	Seminar	0-0-2	1 Credits

Examination Scheme: Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the seminar
CO2	Explain the motivation for selecting the seminar topic and its scope
CO3	Search pertinent literature and information on the topic
CO4	Critically review the literature and information collected
CO5	Demonstrate effective written and verbal communication

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2					2	2	2	2	1		1
CO2								2		2		1
CO3	2					1	1	1	3	3		3
CO4	2		1			2	1	2	2	2		2
CO5												

Course Contents:

Before the end of Semester VII, each student will have to deliver a seminar on a subject mutually decided by candidate and his/her guide. The student should select the topic for his/her seminar which is latest and relevant. The student, as a part of the term work, should submit the write-up of the seminar topic in duplicate, typed on A4size sheets in a prescribed format and bound at the end of semester.
The performance of the student will be evaluated on the basis of the contents, the presentation and discussion during the delivery of seminar before the evaluation committee appointed by the Department.

Field Training/ Internship/ Industrial Training III

BTPRF709	Project 5	Field Training/ Internship/ Industrial Training III	---	1 Credit

Examination Scheme: End Semester Exam: 50 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	To make the students aware of industrial culture and organizational setup
CO2	To create awareness about technical report writing among the student.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		1	1			2		1			3	3
CO2		1	1			2		1			3	2

Students will have to undergo 6 weeks training programme in the Industry during the summer vacation after VIth semester examination. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.

Also, students should take up a small case study and propose the possible solution(s).

They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in final year B.Tech. Programme. They will have to give a power point presentation in front of the group of examiners.

Project Stage-I

BTPRP710	Project 6	Project Stage-I	0-0-6	3 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 6 hrs/week	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the exact title of the project and problem definition
CO2	Explain the motivation, objectives and scope of the project
CO3	Review the literature related to the selected topic of the project
CO4	Design the mechanism, components of the system and prepare detailed drawings.
CO5	Evaluate the cost considering different materials/manufacturing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1								1		
CO2									1	2	2	
CO3		1				1						
CO4			3	2	2		1		1	1	1	1
CO5	1		1					1			2	1

Course Contents:

The students in a group of not more than FOUR will work under the guidance of the faculty member on the project work undertaken by them. The completion of work, the submission of the report and assessment should be done at the end of VII Sem.

The project work should consist of any of the following or appropriate combination:

1. A comprehensive and up-to-date survey of literature related to study of a phenomenon or product.
2. Design of any equipment and / or its fabrication and testing.
3. Critical Analysis of any design or process for optimizing the same.
4. Experimental verification of principles used in applications related to various specializations related to Mechanical Engineering.
5. Software development for particular applications.
6. A combination of the above.

It is expected that the students should complete at least 40% of the total project work in VII Semester. The objective is to prepare the students to examine any design or process or phenomenon from all angles, to encourage the process of independent thinking and working and to expose them to industry. The students may preferably select the project works from their opted elective subjects. The students should submit the report in a prescribed format,

before the end of VIIth semester. The report shall be comprehensive and presented typed on A_4 size sheets and bound. Number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

Semester VIII

Project Stage II/Internship

BTPRP803	Project 7	Project Stage-II or Internship and Project*	0-0-30	15 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 30 hrs/week	Continuous Assessment: 50 Marks End Semester Exam: 100 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the aim and objectives for this stage of the project
CO2	Construct and conduct the tests on the system/product
CO3	Analyze the results of the tests.
CO4	Discuss the findings, draw conclusions, and modify the system/product, if necessary.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2			2	2	2	1	1					
CO3		1			1	2		1		1		
CO4			2	1	2	1	2			3		1

Course Contents:

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II. The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.

B. Tech. in Production Engineering -Final Year (w.e.f 2020-21)

List of all UG courses with their equivalent SWAYAM courses:

Sr.No.	Semester	Name of Subject as per Curriculum	Equivalent SWAYAM/ NPTEL Courses	Relevance %
1	VII	Mechatronics	Mechatronics and manufacturing automation	70%
2	VII	Tool Design	No	-
3	VII	Hydraulic, Pneumatic and Fluidic Control	No	-
4	VII	Additive Manufacturing	No	-
5	VII	Engineering Tribology	Tribology	90%
6	VII	Finite Element Method	Finite Element Method	50%
7	VII	Surface Engineering	Fundamentals of Surface Engineering	20%
8	VII	Automobile Design	No	-
9	VII	Engineering Economics	No	-
10	VII	Intellectual Property Rights	No	-
11	VII	Wind Energy	Wind Energy Technology	90%
12	VII	Knowledge Management	No	-