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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Course Contents for

B. Tech. in Production Engineering

w.e.f. June 2018

From 3rd 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:

PO 1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO 2	Analyze problems of production engineering including manufacturing and industrial systems to formulate design requirements.
PO 3	Design, implement and evaluate production systems and processes considering public health, safety, cultural, societal and environmental issues.
PO 4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO 5	Apply current techniques, skills, knowledge and computer based methods and tools to develop production systems.
PO 6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO 7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO 8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO 9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO 10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO 11	Apply management principles to manage projects in multidisciplinary environment.
PO 12	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 III [Second Year] w.e.f. 2018-2019

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTBSC301	BSC 7	Engineering Mathematics-III	3	1	--	20	20	60	100	4
BTMEC302	ESC 11	Materials Science and Metallurgy	3	1	--	20	20	60	100	4
BTMEC303	PCC 1	Fluid Mechanics	3	1	--	20	20	60	100	4
BTMEC304	PCC 2	Machine Drawing and CAD	2	--	--	20	20	60	100	2
BTPRC305	PCC 3	Theory of Machines	2	1	--	20	20	60	100	3
BTHM3401	HSMC 3	Basic Human Rights	2	--	--	50	--	--	50	Audit (AU/NP)
BTPRL307	ESC 12	Materials Science and Metallurgy Lab	--	--	2	60	--	40	100	1
BTPRL308	PCC 4	Fluid Mechanics Lab	--	--	2	60	--	40	100	1
BTPRL309	PCC 5	Machine Drawing and CAD Lab	--	--	4	60	--	40	100	2
BTPRL310	PCC 6	Theory of Machines Lab	--	--	2	60	--	40	100	1
BTPRF311	Project 1	Field Training /Internship/Industrial Training I	--	--	--	--	--	50	50	1
		Total	15	4	10	390	100	510	1000	23

B. Tech. Production Engineering

Course Structure for Semester IV [Second Year] w.e.f. 2018-2019

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTPRC401	PCC 7	Casting &Moulding Technology	2	1	--	20	20	60	100	3
BTPRC402	PCC 8	Engineering Thermodynamics & Heat Transfer	3	1	--	20	20	60	100	4
BTMEC403	PCC 9	Strength of Materials	3	1	--	20	20	60	100	4
BTMEC404	BSC 8	Numerical Methods in Production Engineering	2	1	--	20	20	60	100	3
BTID405	PCC 10	Product Design Engineering	2	--	--	20	20	60	100	2
BTBSE406A	OEC 1	Physics of Engineering Materials	3	--	--	20	20	60	100	3
BTBSE3405A		Advanced Engineering Chemistry								
BTHM3402		Interpersonal Communication Skill & Self Development								
BTPRL407	PCC 11	Production Processes Lab - I	--	--	2	60	--	40	100	1
BTPRL408	PCC 12	Engineering Thermodynamics & Heat Transfer Lab	--	--	2	60	--	40	100	1
BTPRL409	PCC 13	Strength of Materials Lab	--	--	2	60	--	40	100	1
BTPRL410	BSC 9	Numerical Methods Lab	--	--	2	60	--	40	100	1
		Total	15	4	8	360	120	520	1000	23
Minimum 4 weeks training which can be completed partially in third and fourth semester or in at one time.										

B. Tech. Production Engineering

Course Structure for Semester V [Third Year] w.e.f. 2019-2020

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTPRC501	PCC 14	Design of Machine Elements	3	1	--	20	20	60	100	4
BTPRC502	PCC 15	Joining Technology	2	1	--	20	20	60	100	3
BTPRC503	PCC 16	Metal Forming Processes	2	1	--	20	20	60	100	3
BTPRC504	PCC 17	Machine Tools and Metal Cutting	3	1	--	20	20	60	100	4
BTPRC505	PCC 18	Metrology and Quality Control	2	1	--	20	20	60	100	3
BTPRC506A	OEC 2	Knowledge Management	3	--	--	20	20	60	100	3
BTPRC506B		Nanotechnology								
BTPRC506C		Energy Conservation and Management								
BTPRL507	PCC 19	Machine Design Practice	--	--	2	60	--	40	100	1
BTPRL508	PCC 20	Production Processes Lab II	--	--	2	60	--	40	100	1
BTPRL509	PCC 21	Mechanical Measurement & Metrology Lab	--	--	2	60	--	40	100	1
BTPRF510	Project 2	Field Training /Internship/Industrial Training II	--	--	--	--	--	50	50	1
		Total	15	5	6	300	120	530	950	24

B. Tech. Production Engineering

Course Structure for Semester VI [Third Year] w.e.f. 2019-2020

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTPRC601	PCC 22	CAD/CAM/CIM	3	1	--	20	20	60	100	4
BTPRC602	PCC 23	CNC Machines & Programming	2	1	--	20	20	60	100	3
BTPRC603	PCC 24	Industrial Engineering & Management	2	1	--	20	20	60	100	3
BTPRC604A	PEC 1	Flexible Manufacturing Systems	2	1	--	20	20	60	100	3
BTPRC604B		Production Planning and Control								
BTPRC604C		Assembly Planning & Management								
BTPRC604D		Supply Chain Management								
BTPRC605A	OEC 3	Biology for Engineers	3	--	--	20	20	60	100	3
BTPRC605B		Sustainable Development								
BTPRC605C		Renewable Energy Sources								
BTPRC606A	OEC 4	Solar Energy	3	--	--	20	20	60	100	3
BTPRC606B		Wind Energy								
BTPRC606C		Human Resource Management								
BTPRL607	PCC 25	CAD/CAM/CIM Lab	--	--	2	60	--	40	100	1
BTPRL608	PCC 26	CNC Machines & Programming Lab	--	--	2	60	--	40	100	1
BTPRM609	Project 3	Technical Project for Community Services	--	--	4	50	--	50	100	2
		Total	15	4	8	290	120	490	900	23

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	
BTPRC701	PCC 27	Mechatronics	2	1	--	20	20	60	100	3
BTPRC702	PCC 28	Tool Design	2	1	--	20	20	60	100	3
BTPRC703	PCC 29	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								
BTPRC704C		Finite Element Method								
BTPRC704D		Surface Engineering								
BTPRC705A	OEC 5	Engineering Economics	2	1	--	20	20	60	100	3
BTPRC705B		Intellectual Property Rights								
BTPRC705C		Quantitative Techniques in Project Management								
BTPRC705D		Automobile Engineering								
BTPRL706	PCC 30	Mechatronics Lab	--	--	2	60	--	40	100	1
BTPRS707	Project 4	Seminar	--	--	2	50	--	50	100	1
BTPRF708	Project 5	Field Training /Internship/Industrial Training III	--	--	--	--	--	50	50	1
BTPRP709	Project 6	Project Stage-I**	--	--	6	50	--	50	100	3
		Total	10	5	10	260	100	490	850	21

***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	
BTPRC801A	PEC 3	Process Engineering	2	1	--	20	20	60	100	3
BTPRC801B		Modeling of Manufacturing Systems								
BTPRC801C		Robotics								
BTPRC802A	PEC 4	Product Life Cycle Management	2	1	--	20	20	60	100	3
BTPRC802B		Machine Tool Design								
BTPRC802C		Tool Condition Monitoring								
BTPRC803A	PEC 5	Non-conventional Machining	2	1	--	20	20	60	100	3
BTPRC803B		Diamond Turning Technology								
BTPRC803C		Processing and Manufacturing of Semiconductors								
BTPRC804A	PEC 6	Micro Electro-Mechanical Systems	2	1	--	20	20	60	100	3
BTPRC804B		Engineering Optimization								
BTPRC804C		Reliability and Terotechnology								
BTPRC805A	OEC 6	Design of Experiments	2	1	--	20	20	60	100	3
BTPRC805B		Entrepreneurship Development								
BTPRC805C		Plant Maintenance								
BTPRP806	Project 7	Project Stage-II	--	--	12	50	--	50	100	6
		Total	10	5	12	150	100	350	600	21

** In lieu of the Electives, Six months Internship in the industry including project.*
The evaluation should be based on a presentation of the project work done and on a report submitted by the student.

Semester III

Engineering Mathematics-III

BTBSC301	BSC 7	Engineering Mathematics-III	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 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	
CO7	
CO8	

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												
CO6												
CO7												
CO8												

Course Contents:

Unit 1: Laplace Transform [07 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform [07 Hours]

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding

inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform [07 Hours]

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications [07 Hours]

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

Unit 5: Functions of Complex Variables (Differential calculus) [07 Hours]

Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form;Mapping: Translation, magnification and rotation, inversion and reflection , bilinear transformation; Conformal mapping.

Unit 6: Functions of Complex Variables (Integral calculus) [07 Hours]

Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and Their Engineering Applications by Dr. B. B. Singh, Synergy. Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batch-wise. Each class should be divided into three batches for the purpose.
2. The Continuous Assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Material Science and Metallurgy

BTMEC302	ESC 11	Materials Science and Metallurgy	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 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	Study various crystal structures of materials
CO2	Understand mechanical properties of materials and calculations of same using appropriate equations
CO3	Evaluate phase diagrams of various materials
CO4	Suggest appropriate heat treatment process for a given application
CO5	Prepare samples of different materials for metallography
CO6	Recommend appropriate NDT technique for a given application

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	1									
CO2	3	2	2	3	2							
CO3	2	1	2	1	1							
CO4	1	2	2	1	2	1	2	1	1	1		
CO5	1	1	1	3	2		1		1			
CO6	1	1	2	2	2	1	2		1	1		

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Structure of Materials [08 Hours]
Crystal structures, indexing of lattice planes, Indexing of lattice directions, Imperfections in crystals-point defects, line defects, surface and bulk defects, Mechanism of plastic deformation, deformation of single crystal by slip, plastic deformation of polycrystalline materials.

Unit 2: Mechanical Properties and their Testing [08 Hours]
Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, bend test, torsion test, formability, hardness testing, different hardness tests-Vickers, Rockwell, Brinnel, Impact test, fatigue test, creep test.

Unit 3: Equilibrium Diagrams [09 Hours]
Definitions of terms, rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, property variation with microstructures, classification and application of steels, specification of steels, transformation products of austenite, TTTdiagram, critical cooling rate, CCT diagram.

Unit 4: Heat Treatment [07 Hours]
Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbo-nitriding, flame hardening, induction hardening.

Unit 5: Metallography [08 Hours]
Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, macroscopy, sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 6: Strengthening Mechanisms and Non-destructive Testing [08 Hours]
Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye Penetrant inspection, ultrasonic inspection, radiography, eddy current testing, acoustic emission inspection.

Texts:

1. V. D.Kodgire, S.V.Kodgire, "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 24th edition, 2008.
2. W. D.Callister, "Materials Science and Engineering: An Introduction", John Wiley and Sons, 5th edition,2001.
3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.
4. S. H.Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, 2ndedition, 1997.
5. R. A.Higgins, "Engineering Metallurgy: Part I", ELBS, 6th edition, 1996.

References:

1. V. B.John, "Introduction to Engineering Materials", ELBS, 6thedition, 2001.
2. G. F.Carter, D. E.Paul, "Materials Science and Engineering", ASM International, 3rd edition, 2000.
3. T. E.Reed-Hill, R.Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition, 2003.

Fluid Mechanics

BTMEC303	PCC 1	Fluid Mechanics	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**

Lecture: 3 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	Define fluid, define and calculate various properties of fluid
CO2	Calculate hydrostatic forces on the plane and curved surfaces and explain stability of floating bodies
CO3	Explain various types of flow. Calculate acceleration of fluid particles
CO4	Apply Bernoulli's equation and Navier-Stokes equation to simple problems in fluid mechanics
CO5	Explain laminar and turbulent flows on flat plates and through pipes
CO6	Explain and use dimensional analysis to simple problems in fluid mechanics
CO7	Understand boundary layer, drag and lift

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	1							1
CO2	3	3	1	1	1							1
CO3	3	3	1	1	1							1
CO4	3	3										1
CO5	3	3										1
CO6	2	3										1
CO7	2	3										1

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Basics [08 Hours]

Definition of fluid, fluid properties such as viscosity, vapour pressure, compressibility, surface tension, capillarity, Mach number etc., pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression.

Unit 2: Fluid Statics [08 Hours]

Hydrostatic forces on the plane and curved surfaces, centre of pressure, Buoyancy, centre of buoyancy, stability of floating bodies, metacentre and metacentric height its application in shipping.

Unit 3: Fluid Kinematics [08 Hours]

Velocity of fluid particle, types of fluid flow, description of flow, continuity equation, Coordinate freeform, acceleration of fluid particle, rotational and irrotational flow, Laplace's equation in velocity potential and Poisson's equation in stream function, flownet.

Unit 4: Fluid Dynamics [08 Hours]
Momentum equation, development of Euler's equation, Introduction to Navier-Stokes equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as venturimeter, orificemeter, rectangular and triangular notch, pitot tube, orifices, etc.

Unit 5: Types of Flow [08 Hours]
a) Laminar Flow: Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, loss of head due to friction in viscous flow.
b) Turbulent Flow: Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses, HGL and TEL, flow through series and parallel pipes.

Unit 6: Dimensional Analysis [08 Hours]
a) Dimensional Analysis: Dimensional homogeneity, Raleigh's method, Buckingham's theorem, Model analysis, similarity laws and dimensionless numbers.
b) Introduction to boundary layer theory and its analysis.
c) Forces on Submerged bodies: Drag, lift, Drag on cylinder, Development of lift in cylinder.

Texts:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10th edition, 1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5thedition.

References:

1. V. L. Streeter, K. W. Bedfordand E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9thedition, 1998.
2. S. K. Som, G. Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2ndedition, 2003.

Machine Drawing and Computer Aided Drafting

BTMEC304	PCC 2	Machine Drawing and Computer Aided Drafting	2-0-0	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/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	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump , machine tool part etc.

CO5	Represent tolerances and level of surface finish on production drawings
CO6	Understand various creating and editing commands in Auto Cad

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								3	2		1
CO2	2	1							2	1		1
CO3	2								2	1		
CO4	2	2			1				2	1		1
CO5	1	1			1				2	1		1
CO6	1	1			1				2	2		1

Course Contents:

Unit 1: Sectional Views [04 Hours]
Full section, half section, partial section, off-set section, revolved sections, removed sections, auxiliary section, guidelines for hatching, examples on all above types of sections of machine elements.

Unit 2: Study of Machine Elements [04 Hours]
Study of simple machine elements and components such as screwed fasteners, shaft couplings, pipe joints, riveted and welded joints, bearings, gears, etc.

Unit 3: Interpenetration of Surfaces (Emphasis on Applied Cases) [04 Hours]
Line or curve of intersection of two penetrating cylinders, Cone and cylinder, prism and a cylinder, cone and prism, Forged ends, etc.

Unit 4: Drawing of Assembly and Details [04 Hours]
Part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.

Unit 5: Production Drawing and Reading Blue Prints [04 Hours]
Types of production drawings, size, shape and description; limits, fits and tolerances, surface roughness and surface roughness symbols, reading the blue prints.

Unit 6: Computer Aided Drafting [04 Hours]
Introduction to Computer Aided Design and Drafting, Advantages of CADD, study of preliminary AutoCAD commands like drawing, dimensioning, viewing commands. Drawing 3D views in AutoCAD, Introduction to AutoLISP programming.

Texts:

1. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House, Anand, India.
2. N. D. Bhatt, “Machine Drawing”, Charotar Publishing House, Anand, India.
3. Ajeet Sing, “Working with AutoCAD 2000”, Tata McGraw Hill, New Delhi.
4. George Omura, “ABC of AutoLISP”, BPB Publications, New Delhi.

References:

1. Narayana, Kannaiah, Reddy, "Machine Drawing", New Age International Publishers.
2. AutoCAD and AutoLISP manuals from Autodesk Corp. U.S.A.
3. ISCode: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Theory of Machines

BTPRC305	PCC 3	Theory of Machines	2-1-0	3 Credits

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

Pre-Requisites: Engineering Mechanics

Objectives: To understand commonly used mechanisms for industrial applications, develop competency in drawing velocity and acceleration diagrams for simple and complex mechanisms and to understand the concepts of motion transmission elements.

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

CO1	Define basic terminology of kinematics of mechanisms.
CO2	Classify planar mechanisms and calculate its degree of freedom.
CO3	Perform kinematic analysis of a given mechanism using ICR and RV methods.
CO4	Perform kinematic analysis of a given mechanism analytically using vector or complex algebra method.
CO5	Perform kinematic analysis of slider crank mechanism using Klein's construction and analytical approach.

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				1								1
CO3	1	1		2								1
CO4	1	1		2								1
CO5	1	1		2								1

Course Contents:

Unit 1: Fundamentals of Kinematics and mechanisms [06 Hours]

Kinematic Link, Kinematic Pair, Kinematic chain, Structure, mechanism, machine, Types of Constrained Motions, Degrees of Freedom, Grubler's Criterion for Plane Mechanisms, Equivalent linkage Mechanism, Inversions of Four Bar Chain, Single Slider Crank Chain, Double Slider Crank Chain Difference between Spatial and Planner Mechanism. Pantograph, Straight Line Motion mechanisms. Hooke's Joint / Universal Joint.

Unit 2: Velocity and Acceleration Analysis in Mechanisms [06 Hours]
Relative Velocity (Velocity polygon) for Kinematic link.Acceleration Diagram for a Link.Corioli's component of Acceleration.Velocity and acceleration in a Slider Crank Mechanism by Klein's construction.Instantaneous Centre of Rotation (ICR).Angular Velocity Ratio Theorem, Methods of Locating ICR in a Mechanism.Velocity analysis of a Kinematic Link by ICR Method, Body and Space centrode.

Unit 3: Static and Dynamic Force Analysis [06 Hours]
Introduction, Static Equilibrium, Equilibrium of Two Force and Three-Force Members, Resultant effect forces acting on a rigid body, D'Alembert's Principle, Equivalent Dynamic System, Compound Pendulum, Bifilar and Trifilar suspension methods. Static and Dynamic Analysis of inertia forces of Slider-Crank Mechanism by analytical and graphical method.

Unit 4: Friction and Lubrication [06 Hours]
Introduction, Types of Friction, Limiting Friction, Laws of Friction, Coefficient of Friction, Limiting Angle of Friction, Screw Friction, Screw Jack, Torque required to lift and lower the load by a Screw Jack, Efficiency of a Screw Jack, Over Hauling and Self Locking Screws, Efficiency of Self Locking Screws, Rolling Friction, Film Friction, Principles of Thick and Thin Film Lubrication, principles of hydrostatic and hydrodynamic lubrication.

Unit 5: Belt and Chain Drives [06 Hours]
Introduction, Selection of a Belt Drive, Flat and V Belt Drives, Open and cross Belt Drive. Materials used for Belts, Velocity Ratio of Belt Drive, Limiting tension ratio, Slip of Belt, Creep of Belt, Length of Flat Belts, Angle of Contact, Power Transmitted by a Belt, Maximum Power Transmitted by a Belt, Centrifugal Tension and its effect on power transmission. Initial Tension in the Belt, Design of Belt Dimensions, Chain Drive, Advantages and disadvantages of Chain drives, Terms used in Chain Drive, Angular Velocity of the Sprocket.

Unit 6: Introduction to Gears and Governors [06 Hours]
Classification, Terminology, Gear Characteristics, Gear Calculations, Gear Tooth Systems, Gear Tooth Profiles, Gear Materials, Law of Gearing, , Gear trains and its types, Calculation of velocity ratio for different gear trains, Gear Trains with bevel gears: Differential Gear Box. Governors: Introduction, Types of governors, Terms used in Governor, Sensitiveness, Stability and Hunting of Governor, Isochronous Governor, Governor effort and Governor power.

Texts:

1. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

References:

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.

Basic Human Rights

BTHM3401	HSMC 3	Basic Human Rights	2-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week	Audit Course

Pre-Requisites: None

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

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

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												
CO3												
CO4									3			
CO5								2		2		
CO6												1

Course Contents:

Unit 1: The Basic Concepts [04 Hours]
Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

Unit 2: Fundamental Rights and Economic Program [04 Hours]
Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Unit 3: Workers and Human Rights [04 Hours]
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 4: NGOs and Human Rights in India [04 Hours]
Land, Water, Forest issues.

Unit 5: Human Rights in Indian Constitution and Law [04 Hours]
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 6: UDHR and Indian Constitution [04 Hours]
Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References:

1. Shastry, T. S. N., "India and Human Rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives (Law in India)", Oxford India.

Material Science and Metallurgy Lab

BTPRL307	ESC 12	Material Science and Metallurgy Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	

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												

List of Practicals/Experiments/Assignments (any ten experiments from the list)
1. Brinell Hardness Test
2. Rockwell Hardness test
3. Erichson Cupping Test
4. Magnaflux Test
5. Dye Penetrant Test
6. Specimen Preparation for Microscopy

7. Sulphur Print Test
8. Spark Test
9. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
10. Study and drawing of microstructures of heat treated steels
11. Jominy End Quench Test
12. Study and drawing of microstructures of cast irons
13. Study and drawing of microstructures of non-ferrous alloys
14. Hardening of steels of varying carbon percentage

Fluid Mechanics Lab

BTPRL308	PCC 4	Fluid Mechanics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	Understand laminar and Turbulent flow and determine Critical Reynolds number using Reynolds Apparatus
CO2	Verify Bernoulli's theorem
CO3	Determine pressure drop in flow though pipes and pipe fittings
CO4	Verify momentum equation using impact of jet apparatus
CO5	Determine viscosity using viscometer
CO6	Do calibration of pressure gauges, rotameter
CO7	Use manometers for pressure measurement

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	3	1				1	2		1
CO2	1	1	1	3	1				1	2		1
CO3	1	1	1	3	1				1	2		1
CO4	1	1	1	3	1				1	2		1
CO5	1	1	1	3	1				1	2		1
CO6	1	1	1	3	1				1	2		1
CO7	1	1	1	3	1				1	2		1

List of Practicals/ Experiments/ Assignments (any eight experiments from the list)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli's theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determination of pressure drop in pipes of various cross-sections

5. Determination of pressure drops in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer(at least one type)
7. Verification of momentum equation using impact of jet apparatus
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Gauge and differential pressure measurements using various types of manometers, Bourdon type pressure gauge.
11. Demonstration of measurement using these instruments Lab.
12. Experiment to study hydraulic jump.

Machine Drawing and Computer Aided Drafting Lab

BTPRL309	PCC 5	Machine Drawing and Computer-aided Drafting Lab	0-0-4	2 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	Draw Conventional representation of standard machine components, welds, materials etc.
CO2	Draw sectional view of a given machine component.
CO3	Develop Assemble view from details of given component i.e. valve, pump, machine tool part, etc.
CO4	Combine details of given machine component and draw assembled view.
CO5	Use various Auto-Cad commands to draw orthographic projection
CO6	Draw sectional view from pictorial view of given machine component using Auto-Cad

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			
CO2	2	1	1		1				1			1
CO3	3	1	1		1				2	1		2
CO4	3	1	1		1				2	1		1
CO5	2	1	1		2				2	2		1
CO6	1	1	1		1				1	1		1

List of Practicals/ Experiments/ Assignments (minimum six assignments should be completed)

1. One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.

2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignment of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model at least one simple machine component.

Theory of Machines Lab

BTPRL310	PCC 6	Theory of Machines Lab	0-0-2	1 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	Perform graphically kinematic analysis of any planar mechanism using ICR and RV methods.
CO2	Perform graphically kinematic analysis of slider crank mechanism using Klein's construction.
CO3	Demonstrate use of graphical differentiation method for kinematic analysis of slider crank mechanism or any other planar mechanism with a slider.
CO4	Sketch polar diagram for a Hooke's joint.

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							
CO2	1	1	1		1							
CO3	1	1			1							
CO4	1	1			1							

List of Practicals/Experiments/Assignments

List of Experiments (Any 3 experiments from the given list):

1. Determination of Moment of Inertia of rigid bodies by bifilar or trifilar suspension method.
2. Compound Pendulum.
3. Experimental Verification of displacement relation for different shaft angles for single Hook’s Joint.
4. Developing a computer program for velocity and acceleration of slider crank mechanism.

List of drawing Sheets:

1. Graphical solution of problems on velocity & acceleration in mechanisms by Relative velocity & relative acceleration method including problem with Corioli’s component of acceleration.

2. Graphical solution of problems on velocity in mechanisms by ICR method.
3. Klein’s constructions for slider crank mechanism.
4. Inertia force analysis with graphical methods.
5. Straight line motion mechanisms.

Semester IV

Casting and Moulding Technology

BTPRC401	PCC 7	Casting and Moulding Technology	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 make students aware of different casting and moulding processes, foundry practices to design casting for different components.

Pre-Requisites: None

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

CO1	Classify different casting processes, advantages and limitations.
CO2	Identify various patterns and sand moulding processes.
CO3	Outline special casting processes, their advantages and limitations.
CO4	Select pouring and feeding methods of casting.
CO5	Design gating and risering system of casting.
CO6	Identify casting defects and various casting inspection and testing methods.

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	1				1							
CO3	1				1							
CO4	1		1		1							
CO5	1		1		1							
CO6	1				1					1		1

Course Contents:

Unit 1: Introduction to casting processes [06 Hours]

Classification, advantages, limitations, applications of casting, casting terms, sand mold making procedure

Unit 2: Technology of patternmaking, moulding and core making [06 Hours]

Pattern materials, pattern making tools, types of patterns, pattern allowances, methods of Constructing patterns, color coding, tools and equipment's, types of modeling sands, sand Additives, properties of molding sand and testing, molding processes: green sand, dry sand

Molding: advantages, limitations and applications core materials, core prints, core boxes, core making, and chaplets.

Unit 3: Special casting processes [06 Hours]
Shell molding, investment molding, full molding process, CO_2 molding, permanent mold Casting, die casting, centrifugal casting and continuous casting, advantages, limitations and applications

Unit 4: Melting, pouring and feeding [06 Hours]
Introduction of furnaces for ferrous and non-ferrous casting, use, construction, charging and other furnaces

Unit 5: Gating and risering of castings [06 Hours]
Gating system, gates, gating ratio, casting yield and gating system design
Risering of casting: Function, shape, types, location, feeding distance, and its design parameters.

Unit 6: Design considerations and inspection of casting [06 Hours]
Designing for economical molding and eliminating defects, defects in casting, inspection Methods: visual, dimensional, mechanical, metallurgical and NDT

Texts/References:

1. Heine R.W, Loper C.R and Rosenthal P.C , "Principles of metal casting", Tata McGraw Hill Publication Co.1998
2. P. L. Jain , "Principles of foundry technology", Tata McGraw Hill Education , New Delhi, 2003.
3. PN Rao, "Manufacturing Technology - Foundry, Forming and welding", Tata McGraw Hill, New Delhi, 2006.

Engineering Thermodynamics and Heat Transfer

BTPRC402	PCC 8	Engineering Thermodynamics and Heat Transfer	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 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

Objectives: To study fundamental laws of thermodynamics, thermodynamics devices and their applications, to get conversant with steam engineering, vapour cycles and steam turbines. To study air compressors and its applications and various modes of heat transfer.

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

CO1	Define various gas laws and relate them to refrigerator, heat pump and heat engine
CO2	Apply gas laws to vapor processes and classify steam turbine

CO3	Classify various types of fuels and analyze the products of combustion by various methods
CO4	Classify the systems of IC engines and estimate the performance of IC engine
CO5	Compare various modes of heat transfer and apply them for solving various problems
CO6	Classify heat exchangers and estimate the effectiveness of heat exchangers

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	1										
CO3	1											
CO4	1				1							
CO5	1	1										
CO6	1				1							

Course Contents:

Unit 1: Elementary Thermodynamics [08 Hours]

Basics of Thermodynamics, Ideal gas Laws, First Law of Thermodynamics, Steady Flow Energy Equation, Carnot Cycle, reverse Carnot Cycle, Second Law of Thermodynamics, Concept of refrigeration, Heat Pump and Heat Engine.

Unit 2: Vapor Power Cycles [08 Hours]

Vapour power cycles Steam Generation and its properties, Measurement of dryness fraction, Carnot Cycle, Application of Gas laws to vapour processes. Ideal Rankine Cycle, Calculation of Thermal Efficiency, Specific Steam Consumption, Work ratio.

Steam Turbines: Types, construction, working, compounding, velocity diagram, & diagram efficiency (No numerical).

Unit 3: Fuels and Fundamentals of Combustion [08 Hours]

Solid, Liquid and gaseous fuels, Combustion equations, analysis of product of combustion, gravimetric and volumetric analysis, theoretical air, excess air and exhaust gas produced.

Unit 4: I. C. Engines [08 Hours]

Air standard Otto, Diesel cycles(Elementary Numerical treatment), classifications of ICE and systems of I.C. engines such as fuel supply system for SI & CI engines, ignition system, cooling system, lubrication system, Performance of IC Engine –Indicated power, Brake power, Thermal efficiency, Specific fuel consumption(Elementary Numerical).

Unit 5: Heat Transfer [08 Hours]

Introduction and Basic Concepts of Conduction: Application areas of heat transfer in manufacturing and machine tools, Modes and Laws of heat transfer, thermal conductivity, thermal diffusivity, Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance, overall heat transfer

coefficient, conduction, critical radius of insulation for cylinders and spheres, economic thickness of insulation. (Elementary numerical)

Fundamentals of convection: Concept Laminar and turbulent flow, Reynold Number, Prandlt number, Grashoff number, Nusselt Number. Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers.

Fundamentals of Radiation: Fundamental concepts of radiation, different laws of radiation, Concept of: shape factor, radiation between two black and diffuse gray surfaces and radiation shields. (No numerical)

Unit 6: Heat Exchangers [08 Hours]

Introduction to heat exchangers, classification and applications; Heat exchanger analysis – LMTD for parallel and counter flow heat exchanger, concept of effectiveness, NTU method for parallel and counter flow heat exchanger (elementary level/ introduction, no numerical).

Texts:

1. R.K. Rajput, "Thermal Engineering", Laxmi Publications.
2. R. S. Khurmi and Gupta, "Thermal Engineering", S. Chand Publication.

References:

1. S.P. Sukhatme, "Heat Transfer", Orient Longman.
2. Y.A. Cengel, "Thermodynamics – an Engineering approach" Tata McGraw Hill.
3. Eastop, A. Mc'conkey, "Applied Thermodynamics", Pearson Publishers.
4. Holman J.P., "Heat Transfer", Tata McGraw Hill.

Strength of Materials

BTMEC403	PCC 9	Strength of Materials	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 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: Engineering Mechanics

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

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, etc.
CO2	Recognise the stress state (tension, compression, bending, shear, etc.) and calculate the value of stress developed in the component in axial/eccentric static and impact load cases.
CO3	Distinguish between uniaxial and multiaxial stress situation and calculate principal stresses, max. shear stress, their planes and max. normal and shear stresses on a given plane.
CO4	Analyse given beam for calculations of SF and BM

CO5	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods
CO6	Differentiate between beam and column and calculate critical load for a column using Euler's and Rankine's formulae

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												
CO6												

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Simple Stresses and Strains [08 Hours]
Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.

Unit 2: Principal Stresses and Strains [08 Hours]
Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes, Mohr's circle for stresses and strains.
Strain energy and resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, strain energy in terms of principal stresses.

Unit 3: Combined Stresses [08 Hours]
Combined axial and flexural loads, middle third rule, kernel of a section, load applied off the axes of symmetry.
Shear and Moment in Beams: Shear and moment, interpretation of vertical shear and bending moment, relations among load, shear and moment.

Unit 4: Stresses in Beams [08 Hours]
Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear.

Unit 5: Beam Deflections [08 Hours]
Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of area-moment method (Mohr's theorems), moment diagram by parts, deflection of cantilever

beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Unit 6: Torsion [08 Hours]
Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.
Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Texts:
1. S. Ramamrutham, "Strength of Materials", DhanpatRai and Sons, New Delhi.
2. F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
3. S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:
1. E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
2. S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
3. S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.
4. B. C. Punmia, Ashok Jain, Arun Jain, "Strength of Materials", Laxmi Publications.

Numerical Methods in Production Engineering

BTMEC404	BSC 8	Numerical Methods in Production Engineering	2-1-0	3 Credits

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

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

CO1	Describe the concept of error
CO2	Illustrate the concept of various Numerical Techniques
CO3	Evaluate the given Engineering problem using the suitable Numerical Technique
CO4	Develop the computer programming based on the Numerical Techniques

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		1	3							
CO2	3	3		1	3							
CO3	3	3		1	3							
CO4	3	3		1	3							

Course Contents:

Unit 1: Error Analysis [06 Hours]
Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of errors in computer programming.

Unit 2: Roots of Equations [06 Hours]
Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit 3: Numerical Solution of Algebraic Equations [06 Hours]
Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit 4: Numerical Integration and Differentiation [06 Hours]
Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

Unit 5: Curve Fitting and Interpolation [08 Hours]
Motivation, Least Square Regression: Linear Regression, Polynomial regression.
Interpolation: Newton's Divide Difference interpolation, engineering applications.
Solution to Ordinary Differentiation Equations: Motivation**,** Euler's and Modified Euler's Method, Heun's method, Runge– Kutta Method, engineering applications.

Unit6: Computer Programming [04 Hours]
Overview of programming language, Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Reymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publications, 2010.
2. E. Balagurusamy, "Numerical Methods", Tata McGraw Hill Publications, 1999.

References:

1. V. Rajaraman, "Fundamental of Computers", Prentice Hall of India, New Delhi, 2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi, 3rd edition, 2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley, 1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982.

Product Design Engineering

BTID405	PCC 10	Product Design Engineering	2-0-0	2 Credits

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

Unit 1: Creating Simple Products and Modules [04 Hours]

Unit 2: Document Creation and Knowledge Sharing [04 Hours]

Unit 3: Self and Work Management [04 Hours]

Unit 4: Team Work and Communication [04 Hours]

Unit 5: Managing Health and Safety [04 Hours]

Unit 6: Data and Information Management [04 Hours]

Reference:

1. Model Curriculum for "Product Design Engineer – Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)
2. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW-HILL book company.
5. Roozenburg, N. F., & Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.
6. Lidwell, W., Holden, K., & Butler, J.(2010). Universal principles of designs, revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design. Rockport Pub.

Physics of Engineering Materials

BTBSE406A	OEC 1	Physics of Engineering Materials	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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 different types of structures of solid, defects in solids and analysis of crystal structure by X-ray diffraction technique.
CO2	Understand the origin and types of magnetism, significance of hysteresis loo in different magnetic materials and their uses in modern technology
CO3	Understand the band structure of solids and conductivity, categorization of solids on the basis of band structure, significance of Fermi-Dirac probability functions

CO4	Understand the principles of superconductivity, their uses in modern technology
CO5	Understand the position of Fermi level in intrinsic and extrinsic semiconductors, Semiconductor conductivity
CO6	Understand the electric field in dielectric
CO7	Understand basics of Nano materials, synthesis methods and characterization techniques

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	2		3	3		1					3
CO2	3	3			1		2		2		1	2
CO3	2	2			1		1					3
CO4	3	3			1		3		1		1	2
CO5	3	2		2	1		1					1
CO6	3	2			2		2		3		1	2
CO7	2	3	1		3	1	3	1				1

Course Contents:

Unit 1: Crystallography [06 Hours]
Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction.

Unit 2: Magnetic Materials [06 Hours]
Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferrimagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.

Unit 3: Conducting and Superconducting Materials [06 Hours]
Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors (Cryotron, magnetic levitation)

Unit 4: Semiconducting Materials [06 Hours]
Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell

Unit 5: Dielectric Materials [06 Hours]
Dielectric constant and polarizability, types of polarization, temperature and frequency

dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials

Unit 6: Nano Materials [06 Hours]
Nano materials: Introduction and properties, synthesis of nano materials, Carbon Nano Tubes, Characterization techniques of nano materials- SEM, TEM, EDAX, FMR, XRD. Applications of Nano materials.

Texts:

1. Kittle, "Introduction to Solid state Physics", John Wiley and Sons, 8th edition, 2004.
2. M. Srivastava, C. Srinivasan, "Science of Engineering Materials and Carbon Nanotubes", New Age International Publication, 3rd edition, 2010.
3. A. J. Dekker, "Solid State Physics", Pan Macmillan and Co. Ltd., London, 01stJuly, 1969.

References:

1. V. Raghavan, "Material Science and Engineering", Prentice Hall Publication, 5th edition, 2007.
2. A. J. Dekker, "Electrical Engineering Materials", Prentice Hall Publication, 1st edition, 1959.

Advanced Engineering Chemistry

BTBSE3405A	OEC 1	Advanced Engineering Chemistry	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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	Classify and explain various types of Corrosion and should apply methods to minimize the rate of corrosion.
CO2	Understand and apply the concepts of Photochemical and Thermal reactions.
CO3	Understand the basic concepts of Polymers, Polymerization and Moulding techniques; Determine molecular weight of High-Polymers.
CO4	Understand and apply the basic techniques in Chemistry and capable to explain the concepts of Solvent Extraction.
CO5	Understand and apply various types of Spectroscopic, Chromatographic techniques and also able to explain the concepts of Thermo-Gravimetric Analysis (TGA).

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		1		2				1	1
CO2	2	2	1				2		1		1	1
CO3	2	2	2		3	1	1		1		1	1
CO4	3	2	1		3				2		1	1
CO5	3	2	1		3				2		1	1

Course Contents:

Unit 1: Corrosion and Its Control [06 Hours]
Introduction, Fundamental reason, Electrochemical Corrosion, Direct Chemical Corrosion, Factors affecting the rate of corrosion, types of corrosion-Galvanic, Pitting Corrosion, Microbiological corrosion, Stress corrosion, methods to minimise the corrosion: Proper design, Cathodic and Anodic protection.

Unit 2: Metals and Alloys [06 Hours]
Metals: Introduction, Properties of metals and alloys. Occurrence, extraction, properties and uses of Ni, Cr and Ti Alloys: Introduction, Need for alloying Steel, Application of Alloy Steel.

Unit 3: Polymers and Its Characterization [06 Hours]
Introduction, molecular weight determination by osmotic pressure and viscosity method, polymers in medicines and surgery, inorganic polymers: silicones. Classes of polymerization (Synthesis and Characterization).Plastic, Moulding of plastic.

Unit 4: Basic Techniques in Chemistry [06 Hours]
Preparing substances for analysis, dissolving the samples, Precipitation, Filtration, Washing Precipitate, Drying and Igniting precipitate. Solvent Extraction: Aqueous and Organic phase liquid – liquid extraction.

Unit 5: Spectroscopy [06 Hours]
Brief introduction to spectroscopy, UV–Visible Spectroscopy: Laws of absorption, instrumentation and application. IR spectroscopy: introduction, theory, instrumentation and application. Brief discussion on NMR Spectroscopy and its Applications. Brief introduction of AAS (Atomic Absorption Spectroscopy)

Unit 6: Instrumental Methods of Analysis [06 Hours]
Introduction to Chromatography, Types of Chromatography (Adsorption and partition chromatography), Paper and Thin Layer Chromatography, Gas Chromatography – introduction, theory, instrumentation.Brief discussion of Thermo gravimetric analysis (TGA).

Texts:

1. Bhal and Bhal, “Advance Organic Chemistry”, S. Chand and Company, New Delhi, 1995.
2. P. C. Jain, Monica Jain, “Engineering Chemistry”, Dhanpat Rai and Sons, Delhi, 1992.
3. Bhal, Tuli, “Text book of Physical Chemistry”, S. Chand and Company, New Delhi, 1995.
4. Chatwal Anand, “Instrumental Methods of analysis”, Himalaya Publication.

References:

1. L. Finar, "Organic Chemistry", Vol. I and II, Longman Gr. Ltd and English Language Book Society, London.
2. G. M. Barrow, "Physical Chemistry", Tata McGraw Hill Publication, New Delhi.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and applications", Cambridge Publishers, 2015.
4. O. G. Palanna, "Engineering Chemistry", Tata McGraw Hill Publication, New Delhi.
5. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
6. Willard, "Instrumental Methods of analysis", Merrit, Tata McGraw Hill Publications.
7. Glasstone, "Physical Chemistry", D. Van Nostrand Company Inc., 2nd edition, 1946.
8. Peter Atkins, "Physical Chemistry", W. H. Freeman and Co., 9th edition, 2009.

Interpersonal Communication Skill & Self Development

BTHM3402	OEC 1	Interpersonal Communication Skill & Self Development	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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	Acquire interpersonal communication skills
CO2	Develop the ability to work independently.
CO3	Develop the qualities like self-discipline, self-criticism and self-management.
CO4	Have the qualities of time management and discipline.
CO5	Present themselves as an inspiration for others
CO6	Develop themselves as good team leaders

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										2		
CO3												2
CO4									1			
CO5										2		
CO6											3	

Course Contents:

Unit 1: Development of Proficiency in English [06 Hours]
Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups). 5 Wsand 1 H and 7 Cs for effective communication.
Imbibing etiquettes and manners. Study of different pictorial expressions of non-verbal communication and their analysis

Unit 2: Self-Management [06 Hours]
Self-Management, Self-Evaluation, Self-discipline, Self-criticism; Recognition of one's own limits and deficiencies, dependency, etc.; Self-Awareness, Self-Management, Identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride. Leadership and Team Dynamics

Unit 3: Time Management Techniques [06 Hours]
Practice by game playing and other learning strategies to achieve the set targets Time Management Concept; Attendance, Discipline and Punctuality; Acting in time, Quality /Productive time.

Unit 4: Motivation/Inspiration [06 Hours]
Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation.
Motivation techniques: Motivation techniques based on needs and field situations

Unit 5: Interpersonal Skills Development [06 Hours]
Positive Relationship, Positive Attitudes, Empathise: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills.

Unit 6: Effective Computing Skills [06 Hours]
Designing an effective Presentation; Contents, appearance, themes in a presentation, Tone and Language in a presentation, Role and Importance of different tools for effective presentation.

References:

1. Mitra, Barun, "Personality Development and Soft Skills", Oxford University Press, 2016.
2. Ramesh, Gopalswamy, "The Ace of Soft Skills: Attitude, Communication and Etiquette for Success", Pearson Education, 2013.
3. Stephen R. Covey, "Seven Habits of Highly Effective People: Powerful Lessons in Personal Change", Free Press Publisher, 1989.
4. Rosenberg Marshall B., "Nonviolent Communication: A Language of Life" 3rd edition, Puddle dancer Press, 1st September, 2003.

Production Processes Lab I

BTPRL407	PCC 11	Production Processes Lab - I	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks

	External Exam: 40 Marks

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

CO1	Perform plain turning, step turning, knurling, eccentric turning, chamfering and facing operations on lathe.
CO2	Prepare setup and fabricate composite job using milling, shaping and drilling machine.
CO3	Making spur gears on a milling machine.
CO4	Prepare sand casting setup using split pattern for simple component.
CO5	Perform joining of two plate using TIG/MIG welding.
CO6	Demonstrate cutting of a sheet metal using flame cutting.

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		3	1		1		1	2		1
CO2	1	1		3	1		1		1	2		1
CO3	1	1		3	1		1		1	2		1
CO4	2	1		3	1		1		1	2		1
CO5	2	1		3	1		1		1	2		1
CO6	1	1		3	1		1		1	1		1

List of Practicals/Experiments/Assignments

Each student shall be required to submit any six jobs from the following:

1. Making a job with a process plan involving plain, step and taper turning as well thread cutting as operations on a Centre lathe.
2. Preparation of process planning sheet for a job including operations such as milling, drilling and shaping.
3. Making a spur gear using universal dividing head on milling machine.
4. Making a simple component by sand casting using a split pattern.
5. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
6. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
7. An experiment on shearing operation.
8. An experiment on blanking operation.
9. An experiment on drawing operation

Engineering Thermodynamics and Heat Transfer Lab

BTPRL408	PCC 12	Engineering Thermodynamics and Heat Transfer Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: Engineering Thermodynamics and Heat Transfer

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

CO1	Determine the dryness fraction of steam and energy contained in a substance with the help of Bomb calorimeter.
CO2	Illustrate the function of Bosch fuel injection pump and boilers.
CO3	Estimate the performance of diesel/petrol engine.
CO4	Demonstrate reciprocating compressing.
CO5	Determine thermal conductivity of an insulating material.
CO6	Determine effectiveness of parallel and counter flow heat exchanger and emissivity of a specimen.

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											
CO3	1	1		1								
CO4	1	1										
CO5	1	1		1								
CO6	1	1		1								

List of Practicals/Experiments/Assignments

Any eight experiments from the list:

1. Determination of dryness fraction of steam.
2. Trial on bomb calorimeter.
3. Study of MPFI and Bosh fuel injection pump
4. Study of High Pressure Boilers.
5. Test on Diesel/Petrol engine to determine BP, bsfc, Brake thermal efficiency.
6. Trial on reciprocating air compressor.
7. Determination of thermal conductivity of insulating material.
8. Test on parallel & counter flow heat exchanger.
9. Determination of Emissivity of a Test Plate.

Strength of Materials Lab

BTPRL409	PCC 13	Strength of Materials Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	

CO2	
CO3	
CO4	

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												

List of Practicals/Experiments/Assignments (any ten experiments from the list)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Torsion test on mild steel and cast iron solid bars and pipes
5. Flexure test on timber and cast iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminum, and cast iron specimens
9. Experiments on thermal stresses
10. Strain measurement in stress analysis by photo-elasticity
11. Strain measurement involving strain gauges/ rosettes
12. Assignment involving computer programming for simple problems of stress, strain computations.

Numerical Methods Lab

BTPRL410	BSC 9	Numerical Methods Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

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

CO1	
CO2	
CO3	
CO4	

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												

Student should develop the computer programme along with the results on following topics. (Any six)

1. Programme to demonstrate the effect of round off error and significant number
2. Programme to find real single root of an Equation by Bisection Method
3. Programme to find real single root of an Equation by Newton- Raphson Method
4. Programme to solve linear simultaneous algebraic equations
5. Programme to solve the integration using Multi Trapezoidal Rule
6. Programme to solve the integration using Simpson's 1/3 rule
7. Programme to solve simple practical problem using finite difference method
8. Programme to solve ODE

It is expected that student should take up the simple real life problem for writing the programme.

Student should maintain a file containing all the programmes with results in printed form and also submit a CD containing all the programmes in soft form.