Bharatiya Vidya Bhavan's
SARDAR PATEL COLLEGE OF ENGINEERING
(Government Aided Autonomous Institute under Mumbai University)
Andheri (W) Mumbai - 400058

COURSE CONTENTS

(S.Y. B.Tech. in Mechanical Engineering)

Year: 2018-19

List of Courses

BSC-BTM301 Applied Mathematics -III
Course Pre-requisites: - BS-BT101, BS-BT201

Course Objectives:
The main objectives of the course are

1. To learn Laplace & Inverse Laplace transforms and its application to solve differential equations.
2. To understand concept of Fourier series, its complex form and enhance problem solving skills.
3. To understand concept of complex variables and conformal mapping.
4. To learn various matrices, operations and important theorems.

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

1. Solve problems based on Laplace and inverse Laplace transform. Apply theory of Laplace transforms to evaluate real integrals and solve initial & boundary value problems.
2. Solve problem based on Fourier series expansion.
3. Solve complex variable problems.
4. Find rank of matrices, Eigen values and Eigen vectors of matrices

Course Content

Module	Details	Hrs
1	**Laplace Transforms** Function of bounded variation (Statement only) Laplace Transforms of $1, e^{at}, \sin at, \cos at, \sinh at, \cosh at, t^n, erf\left(\sqrt{t}\right), J_0(t)$, Shifting theorems, change of scale, $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\} L\left\{\frac{d^n f(t)}{dt^n}\right\} L\left\{\int_0^t f(u)du\right\}$ Convolution theorem, Evaluation of real integrals using Laplace transforms.	07
2	**Inverse Laplace Transforms** Evaluation of Inverse Laplace Transforms using partial fractions, convolution theorem, shifting theorems and other properties. Application of Laplace Transform to solve initial & boundary value problems involving ordinary differential equation with one dependent variables	06
3	**Fourier Series & Integrals** Orthogonal & Orthonormal set of functions. Fourier series, Determination of Fourier constants, Dirichlet's conditions Fourier series for $f(x),\ x \in [c, c+2\pi]$ and $x \in [c, c+2L]$	05
4	**Fourier Series half range & complex form.** Fourier series of Odd and Even functions Half range Fourier Sine & Cosine series, Parseval's Identity Complex form of Fourier series	05
5	**Complex Variables & Mapping** Functions of complex variable, Analytic functions, Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic functions, Analytic method and Milne Thomson methods to find f(z), orthogonal trajectories.	07

	Conformal mapping, Bilinear transformation, cross ratio, fixed points	
6	**Matrices** Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian & Unitary matrices and their elementary properties. Elementary operations and their use in getting the Rank, Normal form of a matrix, PAQ form, Consistency of system of linear homogeneous and non-homogeneous equations.	06
7	**Eigen values & Cayley Hamilton** Eigen-values and Eigenvectors of a matrix, Cayley- Hamilton theorem, Function of a matrix, Diagonalization of a matrix	06

Text Books: -

1. B S Grewal (2014), "Higher Engineering Mathematics", Khanna Publications, 43rd Edition, ISBN 8174091955, 1315 Pages

Reference Books: -

1. Erwin Kreyszig (2010), "Advanced Engineering Mathematics" Wiley Eastern Limited, Singapore 10th edition, ISBN 8126554231, 1148 Pages.
2. N.P.Bali (2017), Text book of Engineering Mathematics, Laxmi Publications, 9th edition, ISBN:978-81-318-0832-0

Sr. No.	Examination	Module
1	T – I	1 , 2 and part of 3
2	T – II	Remaining part of 3, 4 and part of module 5
3	Final exam	1 to 7

***A total of 10 tutorials to be taken batch wise covering the entire syllabus.**

PCC-BTM302 Strength of Materials
Course Pre-requisites: - ES-BT104, ES-BT204
Course Objectives:

1. To determine the internal forces developed in structural members.
2. To determine the stresses and strains produced in the structural members and machine components and their deformations under various types of loads.
3. To understand analytical methods for determining the strength, stiffness and stability of various load carrying structural members and machine components
4. To study the failure theories

Course Outcomes:

Upon successful completion of the course, students should be able

1. To apply principles of engineering mechanics, science and mathematics to derive equations governing the internal resistance forces in machine components subjected to different types of loading.
2. To identify, formulate and solve for stresses and strains produced in basic components of mechanical engineering systems.
3. To discuss different experimental methods and to analyze and interpret data obtained from the experiments related to strength of materials.
4. To evaluate effect of combined in mechanical components using principal stress computations.

Course Contents:

Module No.	Details	Hrs
01	**Introduction** o Definitions of stress and strain, axial tensile and compressive stresses, shear stress and strain. o Definitions of Hooke's law, elastic limit, modulus of elasticity, yield stress, ultimate stress, modulus of rigidity, bulk modulus, Poisson's ratio, factor of safety, Volumetric strain for tri-axial loading. o Experimental methods such as tensile test, hardness test, impact test, etc.	4
02	**Simple deformations under axial loading** o Deformation of stepped bars, tapering bars, deformation due to self-weight **Thermal stresses:** o Calculation of thermal stresses in structural components	6
03	**Shear Force and Bending Moment in beams**: o Shear force and bending moment diagrams for statically determinate beams including beams with internal Hinges for different types of loading o Relationship between rate of loading, shear force and bending moment.	6
04	**Bending stresses in beams:** o Classical flexural formula for straight beams o Bending stress distribution for different sections o Beams of uniform strength. **Shear stresses in beams:** o Distribution of shear stress across commonly used plane sections o Shear connectors **Shear stresses due to torsion**: o Stress and deflection during torsion of circular shafts – solid, hollow and stepped	9

	○ deflection of shafts fixed at both ends ○ stresses and deflection of helical springs	
05	**Principle stresses:** ○ General equations for transformation of stress ○ Principal planes and principal stresses, maximum shear stress ○ Mohr's circle	**6**
06	**Deflection of beams**: ○ Deflection of beams using double integration and Macaulay's method ○ Maxwell's reciprocal theorem	**5**
07	**Thin cylindrical and spherical shells:** ○ Stress and strain in thin cylinders and spheres due to internal pressure **Buckling of columns:** ○ Euler's theory of columns	**6**

Term Work:

At least one tutorial and/or assignments from each module of the curriculum mentioned for the course.

Text Books:

1. Junnarkar, S. B., and H. J. Shah. *Mechanics of structures (Vol. I)*, *Charotar Pub. House, Anand* (1995).
2. Beer, Ferdinand P., R. Johnston, J. Dewolf, and D.Mazurek. "Mechanics of Materials, McGraw-Hill." (2006).

Reference Books:

1. Gere, James M., and S. P. Timoshenko. "Mechanics of materials Brooks." Cole, Pacific Grove, CA (2001): 815-39.
2. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
3. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

Sr. No.	Examination	Module
1	**T-I**	1, 2
2	**T-II**	3, 4
3	**End Sem**	1 to 7

PCC-BTM304 Material Science
Pre-requisites: - **BS-BT105, BS-BT106**

Course Objectives:

The objective of this course is to:

Make students familiar with of mechanical, physical and chemical properties of common engineering materials- metals, ceramics, polymers and composites with rationale behind these properties and to develop good understanding of these.

Course Outcomes:

Students shall be able to

1. Explain basic concepts of materials science and metallurgy in terms of material properties at micro as well as macro scale and to discuss economic, environmental and social issues of material usage.
2. Categorize different material imperfections and apply this knowledge to explain failures.
3. Demonstrate the concept of iron-carbon equilibrium diagram & phase diagrams and understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
4. Describe about different types of heat treatment methods to tailor the properties of Fe-C alloys and examine properties of nonferrous, ceramic and composite materials.

Course contents:

Module No.	Description	Hours
1	**Introduction:** Historical perspective and Materials Science, Important Mechanical properties of Materials, Classification of materials, Advanced materials ar Smart materials and their examples.	4
2	**Phase diagrams:** Equilibrium phase diagrams, Alloys, substitutional and interstitial solid solutions- Phase diagrams, Kinetics of nucleation and growth, Gibbs-Phase rule, Phase transformations and TTT diagrams. **Iron-carbon equilibrium diagram:** Invariant Reactions, Microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron lever rule.	6
3	**Atomic Arrangements:** Lattice, Unit cells, Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress. ASTM grain size.	6
4	**Heat Treatment:** Different types of heat treatment like annealing, normalizing, tempering, austempering, stress relieving etc. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening	8

	Ductile-Brittle transition: Fatigue, crack initiation and propagation, Creep, generalized creep behavior, stress-strain curves of materials.	
5	**Alloying of steel**: properties of stainless steel and tool steels, merging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and copper-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys	6
6	**Ceramic, Composites & Nano materials:** Ceramic materials, application of ceramics, properties of ceramics, inorganic glasses. **Polymers:** classification of polymers, thermoplastics and mechanical properties, Elastomers, Thermosetting polymers **Composites:** types, characteristics and applications **Introduction to Nano materials:** Nano structured materials. Nano clusters & Nano crystals.	7
7	**Economic, environmental and social issues of material usage:** Economic considerations, Environmental and societal considerations, Recycling issues, Materials used in constructions.	5

Text Books:

1. Callister, William D., and David G. Rethwisch. Materials science and engineering: an introduction. Vol. 7. New York: Wiley, 2007.
2. Kodgire, V. D., and S. V. Kodgire. "Material science and metallurgy." Everest Publication, 2009.
3. Balasubramaniam, R. Callister's Materials Science and Engineering: Indian Adaptation (W/Cd). John Wiley & Sons, 2009.
4. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.

Reference Books:

1. Lawrence, H., and Van Vlack. "Elements of materials science and engineering." (1989).
2. Guy, Albert G. *Physical metallurgy for engineers*. Addison-Wesley Pub. Co., 1962.

Sr. No.	Examination	Module
1	**T-I**	1,2 and part of 3
2	**T-II**	Remaining part of 3,4 and part of module 5
3	**End Sem**	1 to 7

PCC-BTM305 Thermodynamics
Pre-requisites: **BS-BT105, BS-BT106**

Course Objectives:

The objectives of this course are:
1. **To explain** the fundamental concepts and principles of Classical Thermodynamics.
2. **To explain** the Laws of Thermodynamics and **illustrate** its **applications** to practical Non-Reactive Thermal Systems.
3. **To explain** various fundamental thermodynamic cycles viz: - Vapor Power Cycles, Gas Power Cycles and Refrigeration Cycles and **illustrate** its **applications** in Steam Power Plants, I.C. Engines and Automobiles, Gas Turbines and Jet Propulsion, and Refrigeration systems.
4. **To explain** the fundamental concepts and the Laws of Thermodynamics for Reactive Systems and **illustrate** its **applications** to practical Reactive Thermal Systems involving Combustion.

Course Outcomes:

Upon successful completion of this course, the students should be able
1.**To explain, exemplify** the fundamental concepts and principles of Classical Thermodynamics, **apply** them for thermodynamic analysis of practical Non-Reactive Thermal Systems and **evaluate** their thermodynamic properties and energy interactions.
2. **To explain, exemplify, interpret** the Laws of Thermodynamics to various thermal systems and **evaluate** their thermodynamic properties, energy interactions and performance parameters.
3. **To explain** the fundamental principles, features of arrangements and operations of various practical thermodynamic cycles viz: - Vapor Power Cycles, Gas Power Cycles and Refrigeration Cycles, and **apply** the acquired knowledge **to evaluate, interpret and compare** performance parameters of these cycles and systems used in Steam Power Plants, I.C.Engines and Automobiles, Gas Turbines and Jet Propulsion, and Refrigeration systems.
4. To **explain** the fundamental concepts and Laws of Thermodynamics for Reactive Systems and **apply** to **analyse** the practical Reactive Thermal Systems involving process of Combustion.

Course Contents:		
Module No.	**Details**	**Hrs.**
1.	**Fundamental Concepts:** Macroscopic Vs. Microscopic approach, Thermodynamic system, surrounding and universe, Control Volume, Thermodynamic State, Properties, Process and Cycle, Thermodynamic Equilibrium, Quasi-Static process, State and Path functions, Work Transfer, Displacement work and other types of work transfers, Free expansion, Net Work Transfer, Heat Transfer	06
2.	**First Law of Thermodynamics:** Statement and expressions for First Law of Thermodynamics for a Closed System undergoing a Cycle and Change of State, Concepts of Energy, Internal Energy, Enthalpy, Specific heats, Latent heats, PMM-I. Steady Flow process, Steady Flow Energy Equation (SFEE), First Law of Thermodynamics (SFEE) applied to various thermal devices such as boilers, nozzles and diffusers, turbines and engines, compressors and pumps, throttling device, condensers and heat exchangers.	06

	Zeroth Law of Thermodynamics: Statement, Temperature measurement, IPTS.	
3.	**Second Law of Thermodynamics**: Limitations of First Law of Thermodynamics, Cyclic Heat Engine, Energy Reservoirs, Kelvin-Planck and Claussius' statements and their equivalence, Refrigerator and Heat Pump, Reversibility and Irreversibility, Causes and conditions of Irreversibility, Carnot Cycle, Reversed Heat Engine, Carnot Theorem and its corollary, Absolute Thermodynamic Temperature Scale. **Refrigeration Cycles:** Reversed Heat Engine Cycle, Vapour Compression Refrigeration (VCR) Cycle, Performance and Capacity of a simple VCR Plant.	06
4.	**Entropy:** Claussius' Theorem, The Inequality of Claussius,Entropy-a Property, Entropy change in an irreversible process, Principle of Entropy,Entropy and Direction, Entropy and Disorder. **Energy:** Available Energy of a Cycle, Law of Degradation of Energy, Reversible Work in a Nonflow and Steady Flow Process, Useful Work, Dead State, Availability in a Nonflow and Steady Flow Process, Irreversibility.	06
5.	**Vapor Power Cycles:** Properties of Pure Substances,Property Diagrams- p-v, T-s and h-s Diagrams, Dryness Fraction, Use of Steam Tables and Mollier Diagram, Rankine Cycle, Actual Vapour Cycle, Comparison of Rankine and Carnot Cycle, Reheat Cycle, Ideal Regenerative Cycle, Regebnerative Cycle, Reheat-Regenarative Cycle, Efficiencies in Staem Power Plant.	06
6.	**Gas Power Cycles:** Carnot Cycle, Overview of reciprocating I.C.Engine, Air Standard Cycles- Otto Cycle, Diesel Cycle, Dual Cycle and their comparison, Brayton Cycle, Comparision of Brayton Cycle with Otto Cycle and Rankine Cycle, Brayton Cycle with Intercooling, Reheating and Regeneration., Jet Propulsion Cycle.	06
7.	**Thermodynamics of Reactive Systems:** Degree of Reaction, Reaction Equilibrium, Law of Mass Action, Heat of Reaction, Gibbs' Function Change, Heat Capacity of Reacting Gases in Equilibrium. **Combustion Thermodynamics:** Enthalpy of Formation, First Law for Reactive Systems, Adiabatic Flame Temperature, Enthalpy and Internal Energy of Combustion, Third Law of Thermodynamics, Second Law Analysis of Reactive Systems.	06

Term Work:

At least one assignment on each module comprising analytical solutions of numerical problems based on course contents. Use of EXCEL / MATLAB to solve simple representative problems is desirable. Required attendance in Lectures and Tutorials, involvement in academic activities related to course and overall conduct carry weightage in assessment of Term Work.

Text Books:

1. Nag, P.K., *Engineering Thermodynamics*, 5th edn, Tata McGraw Hill, New Delhi, 2013.
2. Cengel, Yunus A., and Boles, Michael A., *Therhmodynamics An Engineering Approach*, 8th edn, McGraw Hill,New York, 2014.
3. Holman, J.P., *Thermodynamics*, McGraw Hill, New York, 1987.

Reference Books:

1. Achuthan, M., *Engineering Thermodynamics*, Prentice Hall India Pvt., Limited, 2004.
2. Saad, Michel A., *Thermodynamics for Engineers- Principles and Practice*, 1997.
3. Eastop, T. D., and A. McConkey, *Applied Thermodynamics for Engineering Technologists,* 1996
4. Sonntag, Richard Edwin, Claus Borgnakke, Gordon John Van Wylen, and Steve Van Wyk. *Fundamentals of Thermodynamics*. Vol. 6. New York: Wiley, 1998.

Sr. No.	Examination	Module
1	**T-I**	1, 2
2	**T-II**	3, 4
3	**End Sem**	1 to 7

PCC-BTM306 Manufacturing Science
Course Pre-requisites: - BS-BT105, BS-BT106, BS-BT205, BS-BT206

Course Objectives:
The objective of this course is to:

- To impart understanding and appreciation of breadth and depth of the field of manufacturing.
- To impart basic concept, process parameters & capabilities of manufacturing processes like, Casting, plastic moulding and metal surface treatment.
- To impart knowledge of parts and working of various machines like, Lathe, Milling, Drilling, Surface Grinding & Shaper, and the tools used in these machines. Also to add knowledge of use of Jigs and fixtures.
- To learn and apply the concepts of machining for particular component, by deciding sequence of operations and concerned machine tool requirement for same
- To make the students aware of the basic welding processes and their specific method of application. To learn and apply the concepts of non conventional manufacturing processes for products of different design and material

Course Outcomes:
Upon successful completion of the course, students should be able to
1. Student will broaden the knowledge and perspective of the manufacturing world in which many of the students will contribute their talents and leadership
2. Student will be able to decide/select the manufacturing processes and jigs and fixture, which they have learned to manufacture any new product
3. Students will be conversant with the unconventional machining processes, basic welding, molding and metal surface treatment processes and will be able to identify the process needed and its limitation
4. Student will be able to explain construction & working principles of machines like Lathe, Milling, drilling etc. & their application.

Course contents:

Sr. No.	Description	Duration (hrs.)
1	**Pattern making and Foundry**: Materials used for pattern making, Types of pattern, allowance Pattern, core box, core prints and cores. Plastic molding: Compression molding, Injection molding, Blow molding, Transfer molding, shell molding, carbon dioxide molding Casting: Gravity die or permanent mold casting, pressure die casting, cold chamber die casting, centrifugal casting, , investment mold casting, Plaster mold casting, continuous casting. Metal surface treatment: Electroplating, galvanizing, anodizing, metal spraying.	06
2	**Lathes**: type of lathes, their construction and working, operation of lathes, attachments and accessories used on lathe, type of tools, cutting speed, feed, depth of cut and machining time. Capstan and	06

	turret lathes, tooling for simple jobs. NC, CNC and DNC machines, machining centers and types.	
3	**Milling Machines**: types of machines, horizontal, universal, vertical, Cutters and their applications, Operation on milling machines, Use of dividing head and circular table. Direct, simple, compound, differential and angular indexing Table feed in milling. Work holding devices.	06
4	**Drilling Machines**: Types of machines, Types of drillings, operations such as drilling, boring, reaming, spot facing, counter boring, counter sinking and tapping. Drill speeds and feeds. **Planor machines, shaping machines and slotting machine**: Various types, construction and working of machine, operations and tools, field of application, quick return mechanism feed mechanisms of these machines	05
5	**Design of Jigs and Fixtures**, Introduction, need, Definitions, Principles of location, types of locators, Principles of Clamping, Types of clamping, Jig Bushes and types of Jig Bushes, Indexing devices, Fool proofing means, Types of Jigs and fixtures, Box Jig, Milling fixtures, etc., Design principles for Jigs and fixtures, Design of Jigs and Fixtures	06
6	**Grinding**: Grinding machines such as pedestal, cylindrical surface, centre less and tool and cutter grinder. Operations on the above mentioned machines. Grinding wheel, selection and specifications. Dressing and trimming of grinding wheels. Finishing operations such as lapping and honing. Green Manufacturing	05
7	**Welding**: Riveting, soldering and brazing, fusion welding, gas and arc welding, submerged arc welding-inert gas welding, electro slag welding, thermit welding, welding equipments, Pressure welding – Solid phase welding, resistance and friction welding- other miscellaneous welding processes, weld joint types, weldability. **Non Conventional Machining Processes**: Abrasive jet machining, Electric discharge machining, Electron beam machining, Plasma arc machining, Ultrasonic machining etc.	08

Recommended Books:

Text Books:

1. S. Kalpakjian & S.R. Schmid, "Manufacturing Engineering and Technology, fourth edition", PEARSON
2. O.P. Khanna, "A Textbook of Production Technology", Dhanpat Rai Publications
3. Dr. P.C. Sharma, "*Production Technology*", S Chand and Co.
4. M. Lal and O P Khanna, "*Textbook of Foundary Technology*", S Chand and Co.

Reference Books:

1. G. Boothroyd & W.A. Knight, "Fundamental of Machining and Machine Tools, third edition", CRC.
2. Milton C. Shaw, "Metal Cutting Principles", OXFORD University Press
3. W. A. J. Chapman, "*Workshop Technology- Part I, II and III*", Edward Arnold
4. S K & A K Hajra Choudhary, "*Workshop Technology, Vol. I, II*", Media promotors and publishers pvt. Limited, 2007
5. L E Doyle, "*Manufacturing Processes & materials for Engineers*", Prentice Hall
6. Cyril Donaldson, Tool Design, Tata McGraw Hill, 2012

Recommended websites:

- www.nptel.ac.in
- www.swayam.gov.in

Term work:
1. One assignment on each module of the syllabus.
2. Industrial visit report (format should be provided by teacher)
3. Seminar presentation on the topic related to any one of the topics [Desirable: inclusion of video of the manufacturing process of any product]
4. Tutorial in every instructional week.
5. One Guest lecture by industry expert.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Sem	1 to 7

HSM-BTM307 Organizational Communication and Interpersonal Skills
Course Pre-requisites: - HSM-BT107

COURSE OBJECTIVE:

1. To inculcate in students professional and ethical attitude, effective communication skills, team work, interpersonal Skills, and an ability to understand social responsibilities with multi-disciplinary approach.
2. To enable students to communicate in professional and social context with knowledge of business etiquettes.
3. To prepare students for successful career that meets the corporate, industrial and global requirement
4. To help students build an understanding of different organizational cultures, business practices, and social norms to communicate more effectively in domestic and cross-cultural business contexts.
5. To help student's to use a strategic communication model and critical thinking to identify objectives, analyze audiences, and choose the most effective structure and style for delivering strategically sound written and spoken messages.

COURSE OUTCOME:

Upon successful completion of this Course learners will be able to

1. Explain principles of effective group communication, so as to cultivate trust and understanding, develop open participation, and strengthen decision making in work groups and teams.
2. Analyse a company's communication processes or key messages and recommend changes that can help advance communication as an integral part of that organization's management strategy and possess entrepreneurial approach for lifelong learning
3. As a team, design and deliver a presentation that both informs and persuades, using an appropriate visual support strategy with leadership skills and adhering to a specified time limit.
4. Participate and succeed in campus placements and display corporate etiquettes
5. Have education necessary for understanding the impact of engineering solutions on society and demonstrate awareness of contemporary issues.

Course Content:

Module No.	Details	Hrs.
01	**Corporate Etiquettes, Manners and Core Values:** Introduction, Etiquettes and rules of behavior, Professional Conduct, Etiquette in Meetings, Dining Etiquettes.	05
02	**Meetings & Documentations:** Types of meetings, Notice, Agenda, Minutes of the meetings, Strategies for conducting effective meetings.	04

03	**Report writing:** Objectives of report writing, Language and style in a report, Types of reports. **Formats of reports:** Memo, Letter, and Project report Survey based. **Proposal Writing:** Format and style. Technical Proposals: Objectives of technical proposals, Parts of proposals. **Presentation Skills**: A Computer- aided presentation of the Project report.	09
04	**Interpersonal Communication and Soft Skills:** Emotional Intelligence, Leadership Skills, Goal Setting, Team Building, Stress Management, Time Management	10
05	**Career Skills:** Group Discussions Do's and Dont's, Know thy Self (SWOT Analysis), Job Application letter, Writing Effective Resume' and Curriculum Vitae, Interview Skills	04

List of Assignments:

1. Three assignments on report-writing (A Bound report to be submitted on topic given in partial fulfillment of the syllabus report writing, Report content will be graded and counted during presentation, a printed copy of the presentation and a soft copy in the form of CD to be attached with the report).
2. Technical Proposal (Group activity, document of the proposals)
3. Interpersonal Skills: Case Studies, Group Activity and assignments
4. Two assignments on Career Skills (Cover Letter and Resume' Mock Interviews, Practical sessions)
5. Etiquettes case study and role play.
6. Meeting documentation: Role play and written assignment
7. Practical sessions on Group Discussion topics
8. Mock Interviews
9. Presentations on module no. 4 with Power point and role play and videos taken by students.

Distribution of Term Work/ Practical marks shall be as follows: (total 50 marks).

1. Project report presentation : **15 marks**
2. Presentations on Interpersonal topics: **10 Marks**
3. Group Discussion : **10 marks**
4. Attendance**: 05 marks**
5. **Mock Interviews: 10**

Text Books:

1. Lesikar,Flately, Rentz, Pande "Business Communication", Mc Graw Hill, Education Eleventh Edition.

2. R. C. Sharma and Krishna Mohan, "Business Correspondence and Report Writing"

Reference Books:

1. Fred Luthans, "Organisational Behavior", Mc Graw Hill, edition.
2. Huckin and lsen, "Technical Writing and Professional Communication", Mc Graw Hill
3. Wallace and Maters, "Personal Development for Life and Work", Thomson Learning, 12th edition.
4. Heta Murphy, "Effective Business Communication", Mc Graw Hill, edition.
5. B.N. Ghosh, "Managing Soft Skills for Personality Development", Tata McGraw Hill Lehman, Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition
6. Bell Smith, "Management Communication" Wiley India Edition, 3rd edition,
7. Dr. K. Alex, "Soft Skills", S.Chand and Company.

Sr. No.	Examination	Module
1	T – I	01, 2
2	T – II	3, 5
3	Final Examination	1, 2, 3, 4, 5

PCC-BTM352 Strength of Materials Laboratory
Course Pre-requisites: - PCC-302

Course Objectives:

1. To acquire ability to set up an experiment.
2. To record and analyze data from experiments.
3. To correlate experiment results against theoretical predictions
4. To discuss significance of material testing techniques

Course Outcomes:

Upon successful completion of the course, students should be able to

1. Explain underlying principle of the experiment and outline experimental procedure and describe the parts of the experimental setup
2. Accurately record experimental observations and examine correctness of experimental readings
3. Analyze and interpret data obtained through the experiment
4. Prove compliance of experimental data with theory and justify in case results do not comply with theory and/or standard values

List of Experiments to be conducted is as follows.

1. Tension test on mild steel bar (stress- strain behavior, modulus determination)
2. Tension Test on tor-steel
3. Test on cast iron (transverse, tension)
4. Shear test on mild steel, cast iron, brass
5. Torsion test on mild steel bar/cast iron bar
6. Brinell hardness test
7. Rockwell hardness test
8. Izod impact test/Charpy test
9. Flexural test on beam (central point load) *
10. Flexural test on beam (two-point load) *

* For experiment no. 9 and 10, plot load deflection curve and find value of Young's modulus.

List of experiments from Virtual Laboratories (http://vlab.co.in/):

1. Basic Engineering Mechanics and Strength of Materials lab (http://eerc01-iiith.vlabs.ac.in/index.php)
2. Strength-of-Materials lab (http://sm-nitk.vlabs.ac.in)

Term Work:

The term work will comprise of following

1. Journal of laboratory experiments.
2. At least one assignment on each module of the theory course.
3. Oral Examination

PCC-BTM354 Material Science Laboratory
Course Pre-requisites: - PCC-BT304

Course Objective:

1. To familiarize with use of optical laboratory microscope
2. To acquaint with microstructures of Materials.
3. To familiarize with microstructures of steel under different heat-treated conditions.

Course Outcomes:

Students shall be able to

1. Demonstrate the understanding of the procedure to prepare samples for studying microstructure using microscope (metallography).
2. Interpret different phases present in different steels and cast irons.
3. Interpret different failures and dislocations in different material samples.
4. Identify effects of Annealing, Normalizing and Hardening on microstructure of medium carbon steel.

List of Experiments:

The laboratory work shall consist of a journal based on the below mentioned laboratory experiments/study

1. Study of Metallurgical Microscope.
2. Preparation of Specimen for microscopic examination.
3. Study of microstructure of plain carbon steels of various compositions.
4. Study of microstructure of various types of C.I.
5. Study of microstructure of various types of alloy steels.
6. Study of microstructure of non – ferrous metals and their alloys.
7. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
8. Surface hardening and study of microstructure
9. Study of I.S. codes of steels and selection procedure.

Term Work:

The term work will comprise of following

1. Journal of laboratory experiments.
2. At least one assignment on each module of the theory course.
3. Examination (MCQ)
4. Oral Examination

PCC-BTM399 Machine Shop Practice-I

Course Pre-requisites: -

Course Objectives:

The objective of this course is to provide students the hands-on experience about basic manufacturing processes which are nerve centre of any manufacturing industry.

Course Outcome:

Upon successful completion of the course, students should be able

1. To explain the various parts and working of lathe and shaper machines
2. To explain the different tools used in various manufacturing operations such as machining on lathe, shaper, forging and welding.
3. To apply the knowledge of various operations such as Plain turning, taper turning, precision turning on lathe machine Thread cutting on lathe machine Machining plain, horizontal and inclined surfaces on shaper machine, Preparation of composite welding joint, Operations in forging for manufacturing
4. To explain various safety precautions to be followed during machine shop practice.

Course Contents

Job No.	**Details**	**Hrs.**
01	One job on lathe machine involving plain turning, precision turning, taper turning and screw cutting operation.	07
02	One job on shaper involving machining of horizontal and inclined surfaces.	06
03	One job on forging of cutting tools used on lathes such as boring tool.	05
04	One job on forging of parting tool	05
05	One job on welding exercise to make a composite joint such as T-Joint.	05

MC-BT002 Indian Traditional Knowledge

Course Pre-requisites: - Higher Secondary Education

Course Objectives:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course provides an introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system. The course also provides offers an overview of Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course Outcomes:

On successful completion of this course the students will be able to
1. **Explain** basics of Indian tradition and Indian traditional knowledge systems.
2. **Describe** basics of Indian traditional health care, technologies and its scientific perspectives.
3. **Explain** basics of Indian artistic, linguistic and philosophical tradition.
4. **Co-relate** the Indian traditional knowledge in modern scientific perspective.

Course Contents:

Sr. No.	Description	Duration (hrs.)
1	**Indian Tradition:** Fundamental unity of India, India's heroic role in world civilization, The Indian way of life, Introduction to Indian tradition, The Scientific Outlook and Human Values.	06
2	**Basic structure of Indian Knowledge System:** Indian Traditional Scriptures, Exposure to 4-Vedas, 4-Upvedas (Ayurveda, Dhanurveda, Gandharvaveda, Sthapatya etc.), 6-Vedangas (Shiksha, Kalp, Nirukta, Vyakaran, Jyotish), 6-Upangas (Dharmashastra, Meemansa, Puranas, Tarkashastra/Logic) etc.	06
3	**Indian Knowledge System and Modern Science:** Relevance of Science and Spirituality, Science and Technology in Ancient India, Superior intelligence of Indian sages and scientists.	06
4	**Indian Traditional Health Care:** Importance and Practice of Yoga, Pranayam and other prevailing health care techniques.	06
5	**Indian Artistic Tradition:** Introduction and overview of significant art forms in ancient India such as painting, sculpture, Civil Engineering, Architecture, Music, Dance, Literature etc.	06
6	**Indian Linguistic Tradition:** Ancient Indian languages and literary Heritages, Phonology, Morphology, Syntax and Semantics.	06
7	**Indian Philosophical Tradition:** (Sarvadarshan)- Nyay, Viaishepik, Sankhya, Yoga, Meemansa, Brief understanding of Philosophy of Charvaka, Bhagwan Mahaveer Jain, Bhagwan Buddha, Kabeer, Guru Nanak Dev and other eminent ancient Indian Philosophers.	06

Term Activities:

The Term Activities will consist of one assignment on each module, group discussions, presentations, case study on various topics based on above curriculum. Required attendance, involvement in academic activities related to course and overall conduct carry weightage.

Text Books:

1. Ajwani L.H., *Immortal India*, Vora & Co. Publishers, 1997.
2. Swami Jitatmananda, *Modern Physics and Vedanta*, Bharatiya Vidya Bhavan, 2004.
3. Krishnamurthy, V. *Science and Spirituality- A Vedanta Perception,* Bharatiya Vidya Bhavan, 2002.
4. Sharma D.S., The Upanishadas- An Anthology, Bharatiya Vidya Bhavan, 1989.
5. Raman V.V., *Glimpses of Indian Heritage,* Popular Prakashan,1993.

Reference Books:

1. Sivaramakrishnan, V., *Cultural Heritage of India- Course Material*, Bharatiya Vidya Bhavan, Mumbai 5th Edition, 2014.
2. Capra F., Tao of Physics, Shambhala, 2010.
3. Chaterjee S.C. and Datta D.M., *An Introduction to Indian Philosophy,* University of Calcutta, 1984.
4. Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987.
5. Jha V.N., *Language, Thought and Reality.*

1.

Sr. No.	Examination	Module
1	T – I	1, 2
2	T – II	3, 4
3	Final Examination	1 to 7

BSC-BTM401 Applied Mathematics -IV
Course Pre-requisites: - BS-BT101, BS-BT201

Course Objectives:

1. Introduce Statistical methods, probability distribution and testing of hypothesis.
2. Introduce Vector Integration.
3. Introduce PDE and its applications to solve heat equation.

Course Outcomes:

Upon successful completion of course, students will be able to

1. Solve problem in basic statistics, probability, probability distribution, testing of hypothesis.
2. Solve the problem based on vector integration.
3. Solve PDE problems based on heat equation.

Course Content

Module	Details	Hours
1	**Statistics:** Correlation, Karl Pearson coefficient &Spearman's rank Correlation coefficient, linear regression, lines of regression. Curve fitting by the method of least squares.	**8**
2	**Discrete Random Variables:** Random variables, Probability distribution for discrete random variables, Expected value and Variance, Binomial Distribution and Poisson Distribution.	**6**
3	**Continuous Random Variables:** Probability Density Function for continuous random variable, Normal Distribution.	**4**
4	**Sampling Theory:** Sampling distribution. Test of Hypothesis. Level of significance, critical region. Large and small samples. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Test for significance of the difference between sample S.D and population S.D, Test for significance of the difference between the S.D of two samples.	**6**
5	**T-Test:** Student's t-distribution and its properties. Test of significance of small samples. Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples, Chi-square distribution and its properties.	**6**
6	**Vector Integration:** Vector integrals – Line and surface integrals, Green theorem in plane, Stoke's theorem, Gauss's Divergence theorem. Applications of Vector Integrals to mechanical engineering.	**7**
7	**Applications of Partial Differential Equations:** Method of separation of variables to solve Partial Differential Equations. Partial differential equation governing transverse vibrations of an elastic string, its formulation and solution using Fourier series. Heat equation, steady- state configuration for heat flow, Two-dimensional Laplace equation.	**7**

Reference Books:

1. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.
4. Murray Spiegel ,"Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill 2012.

Sr. No.	Examination	Module
1	T – I	1, 2 and part of 3
2	T – II	Remaining part of 3, 4 and part of module 5
3	Final exam	1 to 7

***A total of 10 tutorials to be taken batch wise covering the entire syllabus.**

PCC-BTM402 Kinematics of Machinery
Course Pre-requisites: ES-BTM104, ES-BTM204

Course Objectives

1. To provide basic concept of kinematics analysis of machines and machine members.
2. To give basic knowledge on kinematic and dynamic design of machinery.
3. To understand the relationship between geometry and motion of the part of the machine.
4. To create a basic foundation for static and dynamic force analysis and ultimately for mechanical transmission system.

Course Outcome:

Upon successful completion of the course, student will demonstrate knowledge in

1. Basic concept of kinematics analysis, drawing velocity and acceleration diagrams for different mechanisms.
2. Inversions of kinematic chains, special purpose mechanisms.
3. Selecting belt, chain and gear depending on application.
4. Static and dynamic force analysis for designing mechanical components.

Course Contents:

Module No.	Details	Hrs.
01	**1. Basic Kinematics:** **Structure, Machine, Link and its types** **Kinematics pair -**Lower pair and higher pair, Form closed pair and force closed pairs, Based on relative motion permitted such as revolute, prismatic, cam, helical, globular. **Kinematics chain and Mechanisms:** Grublers criterion for movability of chains and mechanisms, Limitations of Grubler's Criteria. **Inversion of chain:** Study of various mechanisms derived from inversions of following chains (with regard to motion of links of mechanisms, motion modification, quality of motion transmission (uniform, non-uniform, SHM, Non-SHM), limiting positions, dead positions, quick return property, applications). -- Four bar chain (Grashoffian, and non-Grashoffian), Single slider crank chain, and Double slider crank chain.	06
02	**Special Mechanisms:** **Straight line generating Mechanisms:** Exact Straight line generating Mechanisms – Peaucellier and Harts, Approximate straight line generating Mechanisms – Watts, Roberts, Evans and Chebyshev, Offset slider crank mechanisms, Pantograph, Hook joint single and Double Steering gear mechanisms – Ackerman, Devis	06
03	**Velocity and Acceleration Analysis of mechanisms (mechanisms up to 6 links).** Velocity analysis by instantaneous center of rotation method (Graphical approach) Velocity and acceleration analysis by relative method (Graphical approach)	06

04	**Static force analysis of plane mechanisms** Static force analysis, two and three-force member, Four force member, Static force analysis with friction- in four bar chain mechanism and slider crank mechanisms.	03
05	**Cam and Follower-** classification, motion analysis and plotting of displacement-time, velocity –time, jerk-time for uniform velocity, UARM, SHM & Cycloidal motion (combined motions during one stroke excluded), generation of cam profile for roller and flat face follower	06
06	**GEARS:** Law of gearing, Conjugate profile and its graphic construction, Involute and cycloid gear tooth profile, Construction of involute profile, Path of contact, arc of contact, contact ratio for involutes and cycloid tooth, Interference in involutes gears. Critical Numbers of teeth for interference free motion. Methods to control interference in involutes gears.	09
07	**Gear Trains:** Kinematics and dynamic analysis of- simple gear trains, compound gear trains, reverted gear trains, and epi-cyclic gear trains with spur or bevel gear combination. Cyclo drives for high reduction ratio.	06

Term Work:

1.THEORY ORIENTED:

Assignment based on topics covered.

2.PROBLEM ORIENTED:

A Graphic work (on half imperial drawing sheets)

(a) Location of instant center 3P
(b) Velocity analysis by ICR 3P
(c) Velocity analysis by relative method 3P
(d) Velocity – Acceleration analysis by relative method 3P
(e) Construction of involute profiles 1P
(f) Construction of x-t, v-t, a-t, j-t curves of follower motions and cam profile 2P

B Analytical / Numerical work

1. Numerical Problems on gear 3P
2. Numerical Problems on gear trains 3P
3. Numerical Problem on Cams 3P
4. Any two problem using computer programming. (C++/MATLAB) 2P

P = Problem

C. Demonstration with physical models of mechanisms

D. Simulation of motions of mechanism using CAD package (e.g. CATIA)

Recommended Books:

1. Rattan S.S. “Theory of Machines” Tata McGrahill, ed 3, 2016
2. A.Ghosh, A.K. Mallik, “Theory of Mechanisms and Machines”, East West Press, ed.3, 1999.

3. P.L. Ballaney, "Theory of Machines and Mechanisms", Khanna Publishers, 2003.

Sr. No.	Examination	Module
1	T – I	1, 2
2	T – II	3, 4
3	Final exam	1 to 7

PCC-BTM403 Fluid Mechanics
Course Pre-requisites: BS-BT105, BS-BT106

Course Objectives:
The objective of the course is to make student familiar with the mechanics of fluid flow which includes developing knowledge of static and dynamic nature fluid and fluid flow systems, flow related measurements, techniques of fluid flow analysis, internal and external fluid flow, among students.

Course Outcomes:
On successful completion of the course students will

1. have knowledge of fundamentals of static and dynamic behavior of incompressible and compressible fluid.
2. have understanding of performing calculation of different flow quantities and parameters.
3. be able to apply basic principles to solve single phase flow problem.
4. be able to analyze an existing flow system and recommend solution for it.

Course Contents:

Module	Description	Hrs.
1	**Fundamental Concepts:** Continuum, fluid properties - density, pressure, viscosity, surface tension, compressibility. Classification of fluid – Newtonian and Non-Newtonian, Viscous and Inviscid, Compressible and Incompressible.	04
2	**Fluid Statics:** Definition of body forces and surface forces, static pressure, Pascal's law, Derivation of basic hydrostatic equation, Application to manometer, Forces on submerged surfaces, Fluid in rigid body motion, Buoyancy, stability and Archimedes' Principle.	06
3	**Fluid Kinematics:** Velocity and approach of description- Lagrangian and Eulerian, Acceleration, Classification of flow field – one, two and three-dimensional, steady and unsteady, uniform and non-uniform, rotational and irrotational, Laminar and turbulent. Fluid element's translation, rotation and deformation, Flow patterns: streamlines, path lines and streak lines.	06
4	**Fluid Dynamics:** Basic flow conservation equations and method of analysis- Integral and Differential approach. Reynolds Transport Equation and its application. Navier–Stokes equations (without proof) for rectangular and cylindrical co-ordinates. Cases of exact solutions of NS equations: viscous laminar flow of a fluid through a pipe, Couette flow, Euler's equations in two, three dimensions; Bernoulli's equation and its applications	06
5	**Turbulence and Boundary Layer:** Reynolds number and its significance in flow characterization. Concept of turbulence, its measurement, effect on NS equation and flow pattern. Modeling of turbulence and Turbulence models- Prandtle Mixing Length and Turbulent viscosity based models.	08

	Boundary layer and its measurement, its development flat plate with zero pressure gradient Boundary layer equations its solution –Blasius solution (without derivation), Von-Karman momentum integral approach. Description of turbulent velocity profile in boundary layer- viscous, buffer and turbulent.	
6	**Internal and External Flows:** Internal - Laminar flow through pipes and ducts. Deriving velocity profile using NS equation and developing expression to compute other quantities- flow rate, pressure drop, shear stress, friction factor etc. Head losses- major and minor losses, Moody's diagram, Flow through branched pipes. External – Flow over immersed bodies: Plate, Sphere, Cylinder and other objects. Concept of drag and lift, flow separation and methods to control, Streamlined and bluff bodies.	06
7	**Compressible Flow:** Characteristics of compressible flow, Concept of speed of sound, pressure, stagnation and sonic properties, Effect of area variation on flow properties in isentropic flow, Isentropic flow through converging nozzle – critical pressure ratio and chocked flow, Effect of friction and heat transfer on flow properties, High speed flow	06

Recommended Books:

1. Fox and McDonald, "*Introduction to Fluid Mechanics*", John Wiley & Sons, 8ed.
2. Frank M. White, "*Fluid Mechanics*", McGraw Hill, 7ed.
3. Streeter V L and Wylie E B, "*Fluid Mechanics*", McGraw Hill, 8ed.
4. Munson B R and Huebsch W W, "*Fundamentals of Fluid Mechanics*", Wiley, 7ed.
5. Shaughnessy E J, "*Introduction to Fluid Mechanics*", Oxford University Press, 1ed.
6. Yunus Cengel and John Cimbala, "*Fluid Mechanics*", Tata McGraw Hill. 1ed.
7. Potter M C, "*Mechanics of Fluids*", Cengage Learning; 4 ed

Sr. No.	Examination	Module
1	T – I	1, 2
2	T – II	3, 4
3	Final exam	1 to 7

PCC-BTM404 Mechanical Engineering Measurements
Course Pre-requisites: - BS-BT105, BS-BT205

Course Objectives:
The objective of the course is to impart fundamental knowledge of mechanical measurement techniques and data analysis with its application to the measurement of several mechanical engineering quantities.

Course Outcomes:
Upon successful completion of the course, students should be able

1. To describe overall methodology of measurement and fundamental concepts of experimental data analysis
2. To define different types or errors and to discuss uncertainty analysis
3. To examine common techniques used for measurement of mechanical quantities
4. To select measurement system for engineering applications

Course contents:

Module No.	Description	Duration (hrs.)
1	**Introduction:** Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, Modifying and Interfering. **Static characteristics:** Static calibration, Linearity, Static Sensitivity, Accuracy, Precision, Threshold, Resolution, Reproducibility, Hysterisis, Drift, Range and Span etc. **Dynamic characteristics**: Order of instruments, dynamic behavior under standard inputs and key terminology	04
2	**Errors in measurement and data analysis:** Types of errors, factor influencing measurement, methods of elimination, Probable errors, Uncertainity and Uncertanity analysis **Statistical analysis of data:** arithmetic mean, deviation, average deviation, standard deviation, variance.	04
3	**Displacement measurement:** Transducers for displacement measurement – Potentiometers, LVDT, Capacitance type, Digital transducers (Optical Encoder), Nozzle Flapper transducer. **Strain measurement:** Theory of strain gauges, gauge factor, Temperature compensation, Bridge circuit, Orientation of strain gauges for force and torque measurement, Strain gauge based load cells and torque sensors.	05
4	**Angular velocity measurement:** Tachometers, Tachogenerators, Digital tachometers, Stroboscopic methods. **Acceleration measurement:** Theory of accelerometers and vibrometers, Practical accelerometers, strain gauge based and piezoelectric accelerometers.	05
5	**Pressure measurement:** Pressure standards, Elastic pressure transducers viz. Bourdon Tubes, Diaphragms, Bellows and Piezoelectric pressure sensors, **High pressure measurement:** Bridgman gauges. Calibration of pressure sensors. **Vacuum measurement:** Vacuum gauges viz. Mcleod gauge, Pirani gauge, Ionization gauge, Thermal conductivity gauge, Knudsen gauge etc.	06
6	**Temperature measurement:** Thermodynamic Temperature Scale and IPTS,	06

	Electrical methods of temperature measurement viz. Resistance Thermometers, Thermistors, Thermocouples, Pyrometers.	
7	**Flow measurement:** Venturimeter, Orifice meter, flow nozzles, Pitot tube, Rotameter, Hot wire Anemometrs, Turbine flow meters, Laser Doppler Anemometer etc. Miscellaneous measurement: Measurement of liquid level, humidity etc. Digital Instrumentation, Data Acquisition System,	06

Recommended Books:

1. E.O.Dobelin, "Measurement Systems (Applications and Design)", McGraw Hill.
2. A.K. Sawhney&PuneetSawhney, "Mechanical Measurements and Instrumentation & Control", Dhanpat Rai & Co., Twelfth Edition.
3. Thomas Beckwith, N. Lewis Buck, Roy Marangoni, "Mechanical Engineering Measurement", Narosa Publishing House, Bombay.
4. B.C. Nakra and K.K. Chaudhry, "Instrumentation Measurement and Analysis", Tata McGraw Hill. Third Edition.
5. A.K. Thayal, "Instrumentation and Mechanical Measurements".Galgotia Publications Pvt. Ltd.
6. E.O. Dobelin, "Engineering Experimentation", McGraw Hills International Edition
7. J.P. Holman, "Experimental Methods for Engineers", McGraw Hills International Edition.
8. S.P. Venkateshan, "Mechanical Measurements", Ane Books, India.
9. C.S. Rangan, G.R. Sharma, V.S.V. Mani, "Instrumentation Devices and System", Tata Mcgraw Hill, New Delhi.

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Semester	1 to 7

PCC-BTM405 Solid Mechanics
Course Prerequisites: PCC-BTM302

Course Objectives:
The objective of this course is to present the mathematical and physical principles in understanding the linear continuum behavior of solids

Course Outcomes:
Upon successful completion of the course, students should be able to

1. Describe stresses and strains as tensors
2. Explain the deformation behavior of solids under different types of loading
3. Derive mathematical solutions for deformation behavior of simple geometries
4. Discuss solutions using potentials and energy methods

Course contents:

Sr.No.	Description	Duration (hrs)
1	Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions	6
2	Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition	6
3	Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems	6
4	Application of theory to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems	8
5	Solutions using potentials, Energy methods, Strain energy, Resilience, proof Resilience, Calculation of stresses due to suddenly applied load, impact load, Strain energy stored due to shear.	6
6	Introduction to material plasticity, the Bauschinger Effect, the Yield Locus, Yield Surface for Three-Dimensional Stress, Tresca Yield Condition	5
7	Introduction to Fracture mechanics: Stress-intensity factor approach and Griffith criterion	5

Term work:
Assignment based on above topics and seminars.

Recommended Books:

1. Srinath L. S. *Advanced Mechanics of Solids*, McGraw Hill (2017).
2. G. T. Mase, R. E. Smelser and G. E. Mase, *Continuum Mechanics for Engineers*, Third Edition, CRC Press (2004).
3. Schmidt R.J. and Boresi A.P. *Advanced Mechanics of Materials*, Wiley (2009).

Reference Books:

1. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International (1965).
2. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international (1969).

Sr. No.	Examination	Module
1	T-I	1,2
2	T-II	3,4
3	End Semester	1 to 7

PCC-BTM453 Fluid Mechanics Laboratory
Course Prerequisites: PCC-BTM403

Course Objectives:

The objective of this course is to enhance the practical knowledge and understanding of course BTM403 through live examples and by performing experiments which involves principles of fluid mechanics

Course Outcome:

On successful completion of the course, students will

1. have improved understanding of the principals of fluid mechanics.
2. lean to carryout experiment in fluid related problems and apply basic principles to solve real life problem based of fluid mechanics.
3. be able to record experimental data, its interpretation and representation.
4. be able to design simple experimental setup in fluid mechanics

Exp. No.	Details of Laboratory Experiment	Hrs.
1.	To determine specific gravity of a given liquid	02
2.	To verify Archimedes principle and to determine specific gravity of a concrete block	02
3.	To determine the coefficient of discharge of a given orifice plate	02
4.	To determine kinematic viscosity using Hagen-Poiseuille setup and prove that head loss is proportional to volume flow rate	02
5.	To determine the coefficient of discharge of a given Venturimeter	02
6.	To determine Darcy Friction factor for pipes of different diameters	02
7.	To carryout experiment on a given experimental setup to verify Bernoulli's theorem	02
8.	To determine coefficient of impact of a jet in flat and inclined plate	02
9.	Case based numerical calculations involving fundamentals of fluid mechanics	08

Recommended Books:

1. *Fluid Mechanics Laboratory Manual*, Department of Mechanical Engineering, SPCE.

Term Work:

The term work will comprise of following

1. Journal of laboratory experiments.
2. At least one assignment on each module of the theory course.
3. Examination (MCQ)
4. Oral Examination

PCC-BTM454 Mechanical Engineering Measurements Lab.
Pre-requisites: - **PCC-BT205**

Course Objectives:
1. To impart hands on different mechanical engineering measurement system
2. To understand methodology to characterize the measurement systems and error analysis
3. To design and synthesize the measurement system

Course Outcomes:
On successful completion of the course learner should be able to
1. Calibrate the mechanical engineering measurement system.
2. Characterize measurement system and find the error and perform uncertainty analysis
3. Design measurement system
4. Synthesize measurement system/sensor

List of Experiments: Any seven experiments from the following list of experiments:
1. Calibration of pressure gauge using dead weight pressure gauge tester.
2. Calibration of load cell.
3. Calibration of strain gauges.
4. Calibration of LVDT.
5. Calibration of tachometer.
6. Calibration of accelerometer/vibrometer.
7. Calibration of flow meters.
8. Calibration of temperature sensors.
9. Time constant of thermometer.
10. Study of anemometer.
11. Study of Optical Encoders

Term Work:
The term work will comprise of following
1. Journal of laboratory experiments.
2. At least one assignment on each module of the theory course.
3. Mini project on development of measurement system or characterization of sensor in group of 4 students.
4. Examination (MCQ)
5. Oral Examination

PCC-BTM499 Machine Shop Practice-II
Pre-requisites: - **PCC-BTM399**

Course Objective:

The objective of this course is to provide students the hands-on experience about basic manufacturing processes which are nerve centre of any manufacturing industry.

Course Outcomes:

Upon successful completion of the course, students should be able

1. To explain the Various parts and operation of lathe, shaper, milling, drilling, grinding machines
2. To apply the knowledge of various operations such as Plain turning, taper turning, precision turning on lathe machine Thread cutting on lathe machine Machining plain, horizontal and inclined surfaces on shaper machine Preparation of composite welding joint Operations in forging for manufacturing
3. To apply the knowledge of various operations such as precision turning on lathe machine, Boring and taper boring on lathe machine, External and internal thread cutting on lathe machine.
4. To explain various safety precautions to be followed during machine shop practice.

Term Work:-

Job No.	**Details**	**Hrs**
01	One composite job of assembly of minimum three components produced using lathe, shaper, milling, drilling and grinding machines and involving the operations of precision turning, taper turning, taper boring, internal and external threading, shaping plain flat surfaces, slot milling, drilling and grinding etc.	28