Tripura University
(A Central University)

Curriculum

For

B. Tech in Mechanical Engineering

(3rd Semester)

2021

THIRD SEMESTER

Sl. No.	Course Category	Subject Code	Subject Title	L	T	P	Contact Hours/week	Credit	Full Marks
1.	Humanities Science - 2	HU 301	Effective Technical Communication	3	0	0	3	3	100
2.	Basic Science - 7	BS 302	Mathematics-III	2	1	0	3	3	100
3.	Basic Science - 8	BS 303	Biology for Engineers	2	0	0	2	2	100
4.	Engineering Science - 5	ES 304	Engineering Mechanics	2	1	0	3	3	100
5.	Program Core - 1	PC ME 305	Thermodynamics	3	0	0	3	3	100
6.	Program Core - 2	PC ME 306	Fluid Mechanics-I	3	0	0	3	3	100
7.	Program Core - 3	PC ME 307	Strength of Materials-I	3	0	0	3	3	100
8.	Program Core - 4	PC ME 308	Thermodynamics Lab	0	0	2	2	1	100
9.	Program Core - 5	PC ME 309	Machine-Shop Practice	0	0	2	2	1	100
10.	Mandatory Course - 3	MC 310	Indian Constitution	2	0	0	2	0	100
			Total :	**20**	**2**	**4**	**26**	**22**	**1000**

Effective Technical Communication

Course Code	HU 301
Course Title	Effective Technical Communication
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	1st year B.Tech
Course Category	Humanities Science (HS)
Number of classes	36 hours

Course Outcomes:

At the end of the course, the student will be able to -

CO Number	CO Description	K-level
CO-1	Understand the nature and objective of Technical Communication relevantfor the work place as Engineers	K-2
CO-2	Utilize the technical writing for the purposes of Technical Communication and itsexposure in various dimensions.	K-3
CO-3	Develop effective verbal and non-verbal communication skills.	K-3
CO-4	Analyze ethical, legal, cultural, and global issues affecting Technical Communication and Develop appropriate life skills.	K-4

Module 1: Essentials of Communication(09 hrs)

What is Communication, Process of Communication, Levels of communication, The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group) Communication Barriers to communication, Non-verbal Communication, , Technology Enabled communication, Impact of Technology, Selection of appropriate communication Technology, Importance of Technical Communication, Differences between general and technical communication.

Module 2: Technical Writing Skills (09 hrs)

Technical writing process – Choosing right words, phrases and sentence patterns, clarity of purpose, planning content, effective style of writing, formatting, proofreading.
Technical Reports & Proposals: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Writing of Reports & Proposals.
Business letters:Sales & Credit letters; Claim and Adjustment Letters; Letters of Enquiry, Order Placement letters.
Email Writing: Reasons for popularity; guiding principles for composition; some common pitfalls; maintaining common etiquette.

Module: 3 Workplace Communication (09 hrs)

Applying for a job: Skimming advertisements; Writing job applications; Preparing CV, Resume.
Group Discussions: Group Discussion types; GD as a part of selection process; Key skills to succeed in group discussions; Dos and Don'ts of group discussions; Use of body language in GDs.

Job Interviews: Objectives; Types; Stages of Interview, Face to face Interviews; Telephonic Interviews.
Effective Business Presentations: Importance in workplace communication; Planning, Preparing, Organizing, Rehearsing, and Delivering Oral presentations, Handling Questions; Visual aids in presentations; Power Point Presentations
Ethics in Communication: Communication challenges in culturally diverse workforce;Bias-free communication

Module: 4 Developing soft skills/ Life Skills (09 hrs)

Introduction to soft skills: Soft skills as a competitive weapon in today's changing workplace.
Classification of soft skills: Time management, Attitude, Responsibility, Ethics & Values, self-confidence, Teamwork and Interpersonal skills, Problem solving skills.
Personality Development: Developing Right personality to enhance Life Skills, Personality types; Personality attributes; and Leadership Qualities.
Body Language : Emotions displayed by body language:Aggressive,Submissive,Attentive,Nervous,Upset,Bored, Relaxed, Defensive; Hand Shake; Eye Contact; Posture and Positioning.
Personality traits and soft skills in early stages of career advancement and for future career advancement.

List of Software/Learning Websites

1. http://www.free-english-study.com/
2. http://www.english-online.org.uk/course.htm
3. http://www.english-online.org.uk/
4. http://www.talkenglish.com/
5. http://www.learnenglish.de/

References / Suggested Learning Resources:-

1) Sanjay Kumar &PushpLata Communications Skills , 2nd Edition,Oxford University Press
2) Meenakshi Raman & Sangeeta Sharma Technical Communication: Principles & Practice Oxford University Press
3) Barun Kumar Mitra, Personality Development and Soft Skills Oxford University Press.
4) Personality Development, Harold R. Wallace & L. Ann Masters, Cengage Learning, NewDelhi.
5) Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
6) Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
7) Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, McGraw Hill & Co. Ltd., 2001, New Delhi.
8) A Text Book of Scientific and Technical Writing by S.D. Sharma; Vikas Publication, Delhi.
9) Skills for Effective Business Communication by Michael Murphy, Harward University, U.S

Mathematics-III

Course Code	BS 302
Course Title	Mathematics-III
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	B.Tech 1st Year Mathematics
Course Category	Basic Science (BS)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Solve problems in 1st and 2nd order linear Partial Differential Equations.	K-3
CO-2	Showfourier series expansion of a given function and solve PDEs by variables separable method.	K-3
CO-3	Identify mean and variance of a given probability distribution.	K-3
CO-4	Solve numerically algebraic/transcendental equation and ordinary differential equations.	K-3

Course Content:-

Module 1: Partial Differential Equations (10hrs)

First order partial differential equations, solutions of first order linear and quasi-linear partial differential equation (Pp + Qq =R) by Lagrange method. Homogeneous and non-homogeneous type of second order linear differential equation with constant coefficients by complimentary function and particular integral method.

Module 2: Fourier series(08 hrs)

Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions. One-dimensional wave equation and one-dimensional heat flow equation - method of separation of variables - Fourier series solution.

Module 3: Probability (08hrs)

Classical and axiomatic definition of probability, conditional probability, Bayes' theorem, independent events, random variables, expectation and higher order moments, probability mass function and probability density function, distribution function, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, examples of discrete and continuous distributions: Normal, Poisson, Binomial distributions.

Module 4: Numerical Analysis (10hrs)

Numerical solution of algebraic and transcendental equations by Regula-Falsi method Newton-Raphson's method; Finite Differences - Newton's Forward, backward difference interpolation formulae - Lagrange interpolation; Numerical Integration with Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule; Solving

first order differential equations –Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method of 4th order.

References / Suggested Learning Resources:-

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 1965.
2. Rajnish Verma & H.K. Dass, Higher Engineering Mathematics, S Chand, 2014.
3. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993
4. Jain, Iyengar and Jain, Numerical methods for Scientific and Engineering Computation, New Age International Publications, 2008.
5. Erwyn Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition, 2008.

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Biology for Engineers

Course Code	BS-303
Course Title	Biology for Engineers
Number of Credits	2 (L: 2, T: 0, P: 0)
Prerequisites	-
Course Category	Basic Science (BS)
Number of classes	26 hours

Course Outcome:

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Demonstrate the understandingof biology and its branches, major classifications of life,Cells, Cellular systems their functions and biological molecules.	K-2
CO-2	Illustrate the molecular basis of genetic information and the flow of genetic information from DNA to RNA to protein and the concept of mutations, re-combinations and its applications.	K-2
CO-3	Classify microorganisms, growth, nutrition with their various methods used for the isolation, identification, control and maintenance of microbial cultures.	K-4
CO-4	Explain the fundamental principles of energy transactionsin physical and biological and physiological systems, basic metabolisms.	K-2

Course Content:

Module 1: Introduction to Biology, Classification andBiomolecules (8 hours)

Detailed content of the module: Introduction to Biology and its branches. Molecular taxonomy- three major kingdoms of life. Prokaroytic and Eukaryotic cells. Energy and Carbon utilization. Cells: Animal and Plant cell structures and functions. Cell cycle and Cell division. Transport across cell membrane. Cell signaling. Molecules of life. Monomeric units and polymeric structures. Sugars, starch and cellulose. Lipids, Amino acids and proteins. Nucleotides, DNAand RNA. Proteins- structure and function. Proteins as enzymes,

transporters, receptors and structural elements. Enzyme classification. Mechanism of enzyme action. Enzyme kinetics.

Module 2: Fundamentals of genetics and flow of informations (6 hours)

Detailed content of the module: General principles of genetics, Concept of segregation and independent assortment.Molecular basis of information transfer, molecular basis of coding and decoding genetic information. DNA as genetic material. Concept of genetic code. Define gene in terms of complementation and recombination. Mutation. Recombinant DNA technology.Gene mapping. Application of recombinant DNA technology, recombinant products available in the market and at laboratory scale.

Module 3: Microbiology and applications (6 hours)

Detailed content of the module: Microorganisms and environment: Identification and classification of microorganisms. Ecological aspects of single celled organisms.Microbial integrations.Growth, nutrition and reproduction. Growth kinetics.Isolation and identification of microorganisms. Pure cultures and their characteristics. Maintenance of cultures. Sterilization.Physical and chemical methods of control of microorganisms. Management of toxic industrial wastes.

Module 4:Fundamentals of energy transaction and metabolism (6 hours)

Detailed content of the module: Thermodynamics –laws and its application in biological systems. Energy yielding and energy consuming biochemical processes.
Metabolism- Glycolysis & Krebs cycle, Role of ATP and concept of energy change. Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system.
Fundamental aspects of analysis of living systems; quantitative aspects of physiology and engineering applications to clinical medicine based on body fluid balance, solute transport, basic endocrinology, reproduction physiology, neurophysiology, skeletal and smooth muscle physiology.

References / Suggested Learning Resources:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.;Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd. 12th Edition, 2020
2. Guyton and Hall, Medical Physiology, 14th Edition, Elsevier Saunders, 2020.
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman andCompany.
4.Principles of Genetics, D. Peter Snustad and Michael J. Simmons. 7th Edition, Wiley Publisher, 2015
5. Prescott's Microbiology, Joanne Willey and Kathleen Sandman and Dorothy Wood, 2020. 11th Edition McGraw Hill.

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Engineering Mechanics

Course Code	ES 304
Course Title	Engineering Mechanics
Number of Credits	3 (L: 2, T: 1, P: 0)
Prerequisites	---
Course Category	Engineering Science (ES)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Differentiate coplanar, concurrent & non-concurrent forces and their resultants and confidently tackle equilibrium equationsand its applications.	K3
CO-2	Explain centroid of simple figures, centre of gravity, moment of inertia of composite sections & mass moment of inertia of circular plates, cylinder, cone, sphere & hook.	K2
CO-3	Analyze simple truss, compound truss, frame & virtual work.	K4
CO-4	Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, analyze D'Alembert's principle and differentiate longitudinal, transverse, torsional and damped vibrations.	K2

Course Content:-

Module 1: Fundamentals of Engineering Mechanics*:*(9hours)

-Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particleequilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant ofForce System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium ofCoplanar Systems and Spatial Systems; Static Indeterminacy

-Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 2: Centre of Gravity & Moment of Inertia:(9hours)

-Centroid and Centre of Gravity covering, Centroid of simple figures from first principle,centroid of composite sections; Centre of Gravity and its implications;

-Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia,Moment of inertia of standard sections and composite sections; Mass moment inertia of circularplate, Cylinder, Cone, Sphere, Hook.

Module 3: Trusses, Frames & Virtual Work :(9hours)

-Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections;Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zeroforce members; Beams & types of beams; Frames & Machines;

-Virtual Work and Energy Method- Virtual displacements, principle of virtual work for

particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational),energy equation for equilibrium. Applications of energy method for equilibrium. Stability ofequilibrium.

Module 4: Dynamics& Mechanical Vibrations :(9hours)
-Dynamics - Basic terms & General principles of dynamics, Types of motion, Instantaneous centre of rotation in plane motion, D'Alembert's principle and its application, Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.

-Vibration - Basic concepts of Longitudinal, Transverse and Torsional vibrations, Free & Forced vibration, Resonance and its effects, Damped vibration.

Text Books / References:
1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
11.Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
12.Irving, H.Shames, Engineering Mechanics-Statics and Dynamics, by Prentice-Hall of India.
13.Khurmi R. S. (2010), Engineering Mechanics, S. Chand & Co.
14.NPTEL web or video courses on Engineering Mechanics.
15.Timoshenko & D.H.Young, Engineerring Mechanics,Tata McGraw-Hill publishing Co. Ltd.

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Thermodynamics

Course Code	PCME 305
Course Title	Thermodynamics
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	NIL
Course Category	Program Core (PC)
Number of classes	38 hours

Course Outcome:
After completing this course, the students will be able to

CO Number	CO Description	K-level
CO-1	Apply energy balance to systems andcontrol volumes, in situations involving heat and work interactions	K3

CO-2	Interpret the behavior of pure substances and its application in practical problems.	K2
CO-3	Illustrate the second law of thermodynamics and basic thermodynamic cycles	K3
CO-4	Apply the knowledge of entropy, reversibility, irreversibilityand exergy to solve numerical problems	K3

Course Content:

Module 1: Fundamentals: (10 hours)

System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property;Various modes of energy, Internal energy and Enthalpy.

Module 2: Pure Substances&First Law for Flow Processes: (12 hours)

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures,Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties,Mollier's chart.
Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Module 3: Second law &Thermodynamic cycles: (8 hours)

Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.
Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycleand comparison with Carnot cycle.

Module 4: Entropy, Availability & Irreversibility: (8 hours)

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; of s from steam tables-Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

References / Suggested Learning Resources:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co.Ltd.
5. Yunus A.Cenegal and Michael A.Boles, 2002, *Thermodynamics- An Engineering Approach,* Tata McGraw Hill publications

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FLUID MECHANICS-I

Course Code	PC ME-306
Course Title	Fluid Mechanics-I
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	Engineering Physics and Mathematics
Course Category	Program Core (PC)
Number of classes	36 hours

Course Outcome:

After completing this course, the students will be able to

CO Number	CO Description	K-level
CO-1	Explain fluid properties and fluid pressure.	K2
CO-2	Solve problems related to hydrostatics and fluid kinematics.	K3
CO-3	Analyze basic principles related to fluid dynamics.	K4
CO-4	Evaluate basic principles related to laminar flow and turbulent flow.	K5

Course Content:

Module 1: Properties of fluids and fluid pressure: (06 hours)

Mass and weight density, specific gravity, specific volume, viscosity and Newton's law of viscosity, Compressibility, Types of fluid, surface tension and capillarity.

Fluid pressure at a point and Pascal's law, absolute, gauge and vacuum pressures, pressure variation in a fluid at rest, pressure measurement, Manometers and Mechanical Gauges.

Module 2: Hydrostatics and fluid kinematics: (10 hours)

Total pressure and centre of pressure for various plane surfaces and curved surfaces submerged in liquid. Buoyancy, center of buoyancy, metacentre and metacentric height and equilibrium of floating bodies, period of oscillation.

Kinematics of flow: Types of fluid flow, continuity equation in three dimensions, velocity potential function and stream function, forced and free vortex flow.

Module 3: Fluid dynamics (10 hours)

Euler's equation and Bernoulli's equation, application of Bernoulli's equation-venturimeter, orifice-meter, and pitot tube.

Flow through orifices, hydraulic coefficients, time of emptying hemispherical and horizontal cylindrical tank through an orifice at it's bottom. Discharge over rectangular, triangular and trapezoidal notches, velocity of approach.

Module 4: Laminar and turbulent flow (10 hours)

Flow of viscous fluid through circular pipe-velocity distribution and average velocity, Hagen Poiseiulle formula, Kinetic energy correction and Momentum Correction factors, Navier-Stokes equation of motion.

Reynold's experiment, Loss of head due to friction in pipes, Reynold's expression and Prandtl mixing length theory for turbulent shear stress.

References / Suggested Learning Resources:

1. Som, S. K., & Biswas, G. Introduction to fluid mechanics and fluid machines: Tata McGraw-Hill.

2. Cengel, Y., Fluid Mechanics, Tata McGraw-Hill.
3. Bansal, R. K. A textbook of fluid mechanics and hydraulic machines, Laxmi Pub.
4. Rajput, R.K., A Textbook of Fluid Mechanics and Fluid Machines, S. Chand Pub.
5. Kumar, D.S., Fluid Mechanics and Fluid Power Engineering, S.K.Kataria& Sons.
6. NPTEL courses: http://nptel.iitm.ac.in/courses.php - web and video resources on Fluid Mechanics.

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Strength of Materials-I

Course Code	PC ME 307
Course Title	Strength of Materials-I
Number of Credits	3 (L: 3, T: 0, P: 0)
Prerequisites	---
Course Category	ProgramCore (PC)
Number of classes	36 hours

Course Outcome:-

After completion of the course, students will be able to:

CO No	CO Description	K-level
CO-1	Explain the concept of simple stress and strain and different elastic constants.	K2
CO-2	Calculate the principle stresses by both analytical method and graphical method .	K3
CO-3	Draw the S.F. and B.M diagram for beams under different loading conditions.	K4
CO-4	Design simple bending stress and Flexural Stresses.	K4

Course Content:-

Module 1:Concept of stress and strain: (8 hours)

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains , stress and strain diagram, elongation-stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound bars subjected to axial loading. Thermal stress and strain, calculations due to applications of axial loads and variation of temperature in single and compound walls.

Module 2:Compound Stresses and Strains (8 hours)

Compound Stresses and Strains- Two dimensional stress-strain system.Principle planes and principle stresses, methods for determining stresses on oblique section, Analytical method, Graphical method, Mohr's circle, use of Mohr's circle to find Principle stresses.

Module 3:Shear Force and Bending Moment diagrams: (10 hours)

Shear force (SF) and Bending moment (BM) diagrams. SF and BM diagrams for cantilevers, simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module 4:Theory of bending stresses: (10 hours)

Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, Composite beams, bending and shear stresses in composite beams. Flexural Stresses- Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections.

References/ Suggested Learning Resources:-

1. Pytel A H and Singer F L, Strength of Materials, Harper Collins.
2. Dr. R K Bansal, Strength of Materials, Laxmi Publications (P) Ltd.
3. Timoshenko S P and Young D H, Elements of Strength of Materials, East West Press.
4. Beer P F and Johston (Jr) E R, Mechanics of Materials: SI Version, McGraw Hill.
5. Shames, I. H., Pitarresi, J. M., Introduction to Solid Mechanics, Prentice-Hall.
6. Khurmi, R.S., Strength of Materials, S.Chand and Co, Revised edition.
7. NPTEL courses, http://nptel.iitm.ac.in/courses.php, web and video courses on Strength of Materials by Prof. Sharma, S. C., and Prof. Harsha, S. P.
8. Nash W., Strength of Materials Schaum's out line series, Mc Graw Hill.
9. Subramanian, R., Strength of Materials, Oxford University Press, New Delhi.
10. Punmia, Mechanics of Materials, Laxmi Publications.

ThermodynamicsLab

Course Code	PC ME 308
Course Title	Thermodynamics Lab
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	Thermodynamics
Course Category	Program Core (PC)
Number of classes	24 hours

Course Outcome:

After completing this course, the students will be able to

CO Number	CO Description	K-level
CO-1	Implementthermodynamic cycles in thermal system.	K3
CO-2	Execute the Heat Pump and Calorimeter.	K3
CO-3	Test Joule's apparatus.	K4
CO-4	Perform in reciprocating compressors and nozzle.	K3

Course Content:

List of experiments

1. Demonstrationof Open cycle and Closed cycle thermal system.
2. Determination of the COP of the Heat Pump.
3. Demonstrationof Bomb Calorimeter.

4. Performing experiments using Throttling Calorimeter.
5. Performing Joule's Experiment.
6. Demonstrationof Gas cycle and calculation of its efficiency.
7. Demonstrationof CD Nozzle and determination of its efficiency
8. Performing experimentsin Air Compressor and analyzingits principles with Laws of Thermodynamics.

References / Suggested Learning Resources:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India.
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co.Ltd.
5. YunusA.Cenegal and Michael A.Boles, 2002, *Thermodynamics- An Engineering Approach,* Tata McGraw Hill publications.

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Machine-shop Practice

Course Code	PC ME 309
Course Title	Machine-shop Practice
Number of Credits	1 (L: 0, T: 0, P: 2)
Prerequisites	---
Course Category	ProgramCore (PC)
Number of classes	24 hours

Course Outcome:-

After completion of the course, students will be able :

CO No	CO Description	K-level
CO-1	To perform metal cutting operations on Lathe on a given metal rod to obtain any model	K3
CO-2	To perform milling operations on Milling Machine on a given specimen to obtain any model	K4
CO-3	To perform shaping operations on Shaper Machine on a given specimen to obtain a job.	K3
CO-4	To perform grinding operations on Grinding Machine on a given job to obtain a finished job.	K4
CO-5	To perform welding operations to fabricate metallic job.	K4

List of Experiments *(Minimum 6 experiments to be performed).*

Sl. No.	**Practical Exercises**
1.	To perform simple turning operation on Lathe on a given metal rod to obtain a model
2.	To perform taper turning operation on Lathe on a given metal rod to obtain a model
3.	To perform drilling operation on Lathe on a given job
4.	To perform shaping operation on Lathe on a given circular rod to obtain a square rod

5.	To perform milling operations on Milling Machine on a given specimen to obtain any model
6.	To perform indexing operations on Milling Machine on a given specimen to obtain any model
7.	To perform shaping operations on Shaper Machine on a given specimen to obtain a job.
8.	To perform grinding operations on Grinding Machine on a given job to obtain a finished job.
9.	To perform welding operation on Manual Metal Arc Welding (MMAW) for developing the desired welded joint.
10.	To perform welding operation on Submerged Arc Welding (SAW) for developing the desired welded joint.

References/ Suggested Learning Resources:-

1.Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
2. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India,1998. 5. Rao P.N., "Manufacturing Technology"

Indian Constitution

Course Code	MC 310
Course Title	Indian Constitution
Number of Credits	0 (L: 2, T: 0, P: 0)
Prerequisites	Nil
Course Category	Mandatory Course (MC)
Number of classes	25 hours

Course Outcome:-

After completion of the course, students will be able to:

CO Number	CO Description	K-level
CO-1	Explain about framing and nature of Indian Constitution.	K2
CO-2	Identify the fundamental rights and duties of individual and demonstrate the knowledge on Directive Principles of State Policy.	K3
CO-3	Outline the Federal Structure, Centre- State relation, Union Executive and Amendment Procedure	K2
CO-4	Demonstrate the meaning of local self govt., types of local self govt. in rural and urban areas.	K2

Course Content:

Module 1: Constitutional Framework (05 hours)

1. Meaning of Constitutional Law and Constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features of the Constitution of India.

Module 2: Fundamental Rights, Duties and Directive Principles of State Policy (06 hours)

1. Fundamental Rights- Articles 14, 19 and 21.
2. Fundamental Duties.
3. Directive Principles of State Policy; Its Legal Status and Significance

Module 3: Nature of India's Political system (07 hours)

1. Federal structure, Distribution of Legislative and Financial Powers between the Union and States.
2. Parliamentary Form of Government- Powers and Position of President of India.
3. Emergency Provisions.
4. Amendment Procedures of the Constitution of India.

Module 4: Rural and Urban Local Self Govt. (07 hours)

1. 73rd Amendment of the Constitution and Panchayati Raj Institutions.
2. 74th Amendment of the Constitution and Urban Local Self Govt. (Municipal Corporation, Municipal Council and Nagar Panchayat).
3. TTAADC.

References / Suggested Learning Resources:

1. Fadia, B.L- "Indian Govt. and Politics"Sahitya Bhawan, Agra.
2. D.D.Basu- "An introduction to the Constitution of India"Lexis Nexis publichers.
3. M.V.Pylee- "Constitutional Govt. in India"S.Chand and Company Ltd.
4. S.C.Kashyap(ed)- "Perspectives on the constitution"Shipra Publication.
5. B.K. Sharma- "Introduction to the Constitution of India"Prentice Hall India Private Ltd.
6. Bhattacharya, D.C. and Banerjee, Malay- "Indian Govt. and Politics"Vijaya Publishing House
7. J.C. Johari- "Indian Govt. and Politics" (2 vols)
8. Das Nityananda- "Grassroot Democracy and Panchayati Raj in Tripura" Progressive Publichers

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