

**DEPARTMENT OF
MECHANICAL
ENGINEERING**

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**PERIYAR
MANIAMMAI**
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

Board of Studies in Mechanical Engineering

**CURRICULUM (From I – VII Semesters)
& SYLLABUS (From I –IV Semesters)**

*(For the candidates admitted from 2018-19 onwards
Based on Outcome Based Education)*

FOR

**B.Tech. (Mechanical Engineering) PART TIME
DEGREE PROGRAMME**

BOS Date	30.05.2018
29 th ACM Date	09.06.2018

VISION	To be a University of global dynamism with excellence in knowledge and innovation ensuring social responsibility for creating an egalitarian society.
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MISSION	UM1	Offering well balanced programmes with scholarly faculty and state-of-art facilities to impart high level of knowledge.
	UM2	Providing student - centred education and foster their growth in critical thinking, creativity, entrepreneurship, problem solving and collaborative work.
	UM3	Involving progressive and meaningful research with concern for sustainable development.
	UM4	Enabling the students to acquire the skills for global competencies.
	UM5	Inculcating Universal values, Self respect, Gender equality, Dignity and Ethics.

CORE VALUES

- ✚ Student – centric vocation
- ✚ Academic excellence
- ✚ Social Justice, equity, equality, diversity, empowerment, sustainability
- ✚ Skills and use of technology for global competency.
- ✚ Continual improvement
- ✚ Leadership qualities.
- ✚ Societal needs
- ✚ Learning, a life – long process
- ✚ Team work
- ✚ Entrepreneurship for men and women
- ✚ Rural development
- ✚ Basic, Societal, and applied research on Energy, Environment, and Empowerment.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION	To be recognized globally for outstanding education and research in all fields of
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	Mechanical Engineering leading to well qualified engineers, who are innovative, entrepreneurial and successful in studies.
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MISSION	DM1	To inculcate basic mechanical engineering knowledge to students through effective teaching– learning practices with state of art facilities.
	DM2	To impart quality education to enable the students for higher studies, research and Entrepreneurship.
	DM3	To carry out research activities to satisfy the societal and industrial needs towards sustainability.
	DM4	To provide our students with educational experiences that gives them a sound basis for global requirements, team work and lifelong learning.
	DM5	To cater the needs of society in context of mechanical engineering with human ethics values.

Table: 1 Mapping of University Mission (UM) and Department Mission (DM)

	UM 1	UM 2	UM 3	UM 4	UM 5
DM 1	3	1	1	1	1
DM 2	2	3	2	1	0
DM 3	1	1	3	1	2
DM 4	1	2	1	3	1
DM 5	1	1	1	1	3
	8	8	8	7	7

1-Low 2- Medium 3 – High

PROGRAMME EDUCATIONAL OBJECTIVES

Based on the mission of the department, the programme educational objectives is formulated as

PEO1	Mechanical Engineering graduate shall have successful career with good leadership & team work abilities.
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PEO2	Graduate pursue advanced education, research and development, and other creative and innovative efforts in science, engineering, and technology, as well as other professional careers.
PEO3	Graduate shall have ability to apply core technical competency to various engineering problems along with sense of social awareness.
PEO4	Graduate shall engage in lifelong learning by applying contextual technological knowledge for research and value education.

GRADUATE ATTRIBUTES

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

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

PROGRAM OUTCOMES

PO 1	Graduates shall have An ability to apply principles of engineering, basic science, and mathematics to model and analyze components or processes
PO 2	An ability to design and conduct experiments, as well as to analyze and interpret data
PO 3	An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability
PO 4	An ability to function on multi-disciplinary team
PO 5	An ability to identify, formulate, and solve engineering problems
PO 6	An understanding of professional and ethical responsibility
PO 7	An ability to communicate effectively
PO 8	broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
PO 9	An ability to engage in life-long learning
PO 10	A knowledge of contemporary issues relevant to engineering practice
PO 11	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
PO 12	An ability to imbibe principles of engineering, basic science, and mathematics to design and realize physical systems, components, or processes
	PROGRAM SPECIFIC OUTCOME
PSO1	An ability to work professionally in <i>design and manufacturing</i> systems (PSO1)
PSO2	An ability to work professionally in <i>energy</i> systems (PSO2)

**Table 3 Mapping of Program Educational Objectives (PEOs)
with Program Outcomes (POs)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
PEO 1	1	0	2	3	1	1	3	1	2	1	1	1	1	1
PEO 2	3	2	1	1	2	1	1	1	1	1	2	1	2	1
PEO 3	2	2	3	0	2	3	0	2	0	2	1	1	1	1
PEO 4	0	2	1	1	1	1	2	1	3	1	2	2	1	1
	6	6	7	5	6	6	6	5	6	5	6	5	5	4

1 - Low

2 – Medium

3 - High

SEMESTER-WISE STRUCTURE OF CURRICULUM

REGULATIONS – 2018

(Applicable to the students admitted from the Academic year 2018-19)

SEMESTER I

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
BSC101	Basic Science course	Mathematics –I (Calculus & Linear Algebra)	3	1	0	4
ESC 101	Engineering Science courses	Engineering Mechanics	3	1	0	4
PCC- ME 101	Professional Core courses	Materials Engineering	3	0	0	3
PCC- ME 102		Thermodynamics	3	1	0	4
MC-I*	Mandatory Courses*	Environmental Science	-	-	-	0

	TOTAL				15
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*Self study

SEMESTER II

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
BSC 201	Basic Science course	Mathematics –II (ODE& Complex Variables)	3	1	0	4
PCC-ME 201	Professional Core courses	Applied Thermodynamics	3	1	0	4
PCC- ME 202		Fluid Mechanics & Fluid Machines	3	1	0	4
PCC- ME 203		Manufacturing Processes	3	0	0	3
MC-II*	Mandatory courses*	Constitution of India	-	-	-	0
TOTAL						15

*Self study

SEMESTER III

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
BSC- 301	Basic Science Courses	Mathematics III (PDE, Probability & Statistics)	3	1	0	4
PCC- ME 301	Professional Core courses	Heat Transfer	3	1	0	4
PCC- ME 302		Strength of Materials	3	1	0	4
PCC- ME 303		Mechanical Engineering Laboratory (Thermal) I	0	0	3	1.5
MC – III*	Mandatory course	Essence of Indian Traditional Knowledge	0	0	0	0
TOTAL						13.5

*Self study

SEMESTER IV

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCC- ME 401	Professional Core courses	Instrumentation & Control	3	1	0	4
PCC- ME 402		Kinematics & Theory of Machines	3	1	0	4
PCC- ME 403		Solid Mechanics	3	1	0	4

PCC- ME 404		Mechanical Engineering Laboratory (Design) II	0	0	3	1.5
HSMC 401 (OEL I)*	Humanities courses	Humanities I	3	0	0	3
TOTAL						16.5

*Self study

SEMESTER V

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCC- ME 501	Professional Core courses	Manufacturing Technology	4	0	0	4
PCC- ME 502		Design of Machine Elements	3	1	0	4
PEC- MEL 521 - 525	Professional Elective courses	Elective-I	3	0	0	3
PEC- MEL 521 - 525		Elective-II	3	0	0	3
HSMC 502 (OEL II)*	Humanities courses	Humanities II	3	0	0	3
TOTAL						17

*Self study

SEMESTER VI

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PCC- ME 601	Professional Core courses	Automation in Manufacturing	3	0	0	3
PEC- MEL 621 - 625	Professional Elective courses	Elective III	3	0	0	3
PEC- MEL 621 - 625		Elective-IV	3	0	0	3
PCC- ME 602	Professional Core courses	Mechanical Engineering Laboratory III (Manufacturing)	0	0	3	1.5
OEC 603	Humanities and Social Sciences	Open Elective-III (Humanities)	3	0	0	3
TOTAL						13.5

SEMESTER VII

Sub. Code	Category	Name of the Course	Hours per week			C
			L	T	P	
PEC-MEL 731-735	Professional Elective courses	Elective V	3	0	0	3
PROJ-ME 701	Project	Project-IV	0	0	12	6
TOTAL						9

TOTAL CREDITS – 99.5

Semester	Course name	Course Code	L	T	P	C
I	MATHEMATICS 1 (Calculus and Linear Algebra)	BSC 101	3	1	0	4
Course outcome					Domain	
CO1	Apply differential and integral calculus to notions of curvature and to improper integrals.				Cognitive	
CO2	State Rolle's theorem, Mean value theorems, Taylors and Maclaurin theorems with remainders and to apply L'Hospital's rule.				Cognitive	
CO3	Apply power series to tests the convergence of the sequences and series and to find the half range fourier sine and cosine series.				Cognitive	
CO4	Find maxima, minima and saddle points using method of Lagrange multipliers and to find directional derivatives, gradient, curl and divergence.				Cognitive	
CO5	Find eigen values and eigen vectors and to state and verify cayley Hamilton theorem and to use orthogonal transformation to diagonalise the matrix.				Cognitive	

COURSE CONTENT		Hours
UNIT I	CALCULUS	9+3
	Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	
UNIT II	CALCULUS	9+3
	Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and Minima.	
UNIT III	SEQUENCES AND SERIES	9+3
	Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.	
UNIT IV	MULTIVARIABLE CALCULUS (DIFFERENTIATION)	9+3
	Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	
UNIT V	MATRICES	9+3
	Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	
TEXT BOOKS /REFERENCE BOOKS		
<ol style="list-style-type: none"> G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. 		

3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Semester	Course name	Course Code	L	T	P	C
I	Engineering Mechanics	ESC-101	3	1	0	4
Course outcome					Domain	
CO1	<i>Explain</i> the principles forces, laws and their applications.				Cognitive- Understanding Apply	
CO2	<i>Classification</i> of friction, and <i>apply</i> the forces in Trusses and beams.				Cognitive- Understanding Apply	
CO3	<i>Explain</i> and <i>Apply</i> moment of Inertia and Virtual work				Cognitive- Understanding Apply	
CO4	<i>Outline</i> and <i>Examine</i> Dynamics				Cognitive- Understanding Apply	
CO5	<i>Explain</i> free and forced vibration				Cognitive- Remember Understanding	

COURSE CONTENT		Hours
UNIT I	INTRODUCTION TO ENGINEERING MECHANICS	9+6
	Force Systems Basic concepts, Particle equilibrium 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 of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy	
UNIT II	FRICTION AND BASIC STRUCTURAL ANALYSIS	9+6
	Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines	
UNIT III	CENTROID , CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD	9+6
	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 circular plate, Cylinder, Cone, Sphere, Hook.	

	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 of equilibrium.	
UNIT IV	REVIEW OF PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS OF RIGID BODIES	9+6
	Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.	
UNIT V	MECHANICAL VIBRATIONS	9+6
	Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums	
TEXT BOOKS /REFERENCE BOOKS		
<ol style="list-style-type: none"> 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 University Press 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 <p>Upon successful completion of the course, student will have:</p> <ul style="list-style-type: none"> ➤ Ability to apply mathematics, science, and engineering ➤ Ability to design and conduct experiments, as well as to analyze and interpret data ➤ Ability to identify, formulate, and solve engineering problems ➤ Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding of the limitations. ➤ Ability to comprehend the thermodynamics and their corresponding processes that influence the behavior and response of structural components ➤ Ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) and thermodynamics to model, analyze, design, and realize physical systems, components, or processes 		

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	1	1	3	1	1	2	3	2	1	3
CO2	3	2	1	1	3	1	1	2	3	2	1	3
CO3	3	2	1	1	3	1	1	2	3	2	1	3
CO4	3	2	1	1	3	1	1	2	3	2	1	3
CO5	2	2	2	1	3	1	1	3	3	3	1	3

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
I	Materials Engineering	PCC-ME 101	3	0	0	3
Course outcome					Domain	
CO1	<i>Recall</i> the Basic Properties of Engineering Materials.				Cognitive	
CO2	<i>Classify</i> static failure theories.				Cognitive	
CO3	<i>Classify</i> the concepts of iron and steel.				Cognitive	
CO4	<i>Analyze</i> the heat treatment process and its applications.				Cognitive	
CO5	<i>Analyze</i> the properties of alloys.				Cognitive	

COURSE CONTENT		Hours
UNIT I	PROPERTIES OF METALLIC MATERIALS	9
	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. Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	
UNIT II	STATIC FAILURE THEORIES	9
	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non-destructive testing (NDT).	
UNIT III	ALLOYS AND PHASE DIAGRAMS	9
	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	
UNIT IV	HEAT TREATMENT OF MATERIALS	9
	Heat treatment of Steel: Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. 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	
UNIT V	MODERN ENGINEERING MATERIALS	9
	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.	

TEXT BOOKS
1. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India. 2. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4 th Indian Reprint, 2002. 3. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999. 4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.
REFERENCES
1. Koch, C. C. Nanostructured materials: processing and applications: William Andrew Pub. 2. James F Shackelford, S “Introduction to materials Science for Engineers”, 6 th Macmillan Publishing Company, New York, 2004 3. William D Callister Jr, “Materials Science and Engineering – An Introduction”, John Wiley and Sons Inc., 6 th edition, New York, 2003 4. Jayakumar S, “Materials Science”, RK Publishers, Coimbatore, 2004 5. Bolton, W., Engineering materials technology: Butterworth-Heinemann.
E RESOURCES
1. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112 : related web and video resources under Mechanical Engineering & Metallurgy and Material Science categories 2. http://www.intechopen.com/books

TABLE 1: Mapping of CO’s with PO’S:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	3	1	1	-	2	3	3	1	3	2	2
CO2	3	3	1	1	1	-	-	1	1	2	3	2	3	1
CO3	3	2	1	1	1	-	-	1	2	3	1	3	3	1
CO4	2	3	1	3	1	-	-	1	1	2	3	2	3	2
CO5	3	2	3	3	1	1	-	1	3	3	2	1	2	2

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
I	Thermodynamics	PCC-ME 102	3	1	0	4
Course outcome					Domain	
CO1	After completing this course, the students will be able to <i>apply</i> energy balance to systems and control volumes, in situations involving heat and work interactions				Cognitive	
CO2	Students can <i>Study the</i> changes in thermodynamic properties of substances				Cognitive	
CO3	The students will be able to <i>study</i> the performance of energy conversion devices				Cognitive	
CO4	The students will be able to <i>differentiate</i> between high grade and low grade energies.				Cognitive	
CO5	Student can <i>apply</i> the exergy balance to systems operating at different cycles.				Cognitive	

COURSE CONTENT		Hours
UNIT I	BASIC CONCEPTS	12
	Fundamentals - 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.	
UNIT II	LAWS OF THERMODYNAMICS	12
	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	
UNIT III	PROPERTIES OF SUBSTANCES AND STEAM TABLES	12
	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.	
UNIT IV	FLOW PROCESS AND THERMO DYNAMIC RELATIONS	12
	First Law for Flow Processes - 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 Second law - 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.	
UNIT V	ENTROPY AND CYCLES	12
	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; Determination of s from steam	

tables- Principle of increase of entropy; Illustration of processes in T-s 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
 Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

TEXT BOOKS /REFERENCE BOOKS

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

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	-	1	-	3	-	2	2	2	-	-	2
CO2	3	-	-	2	3	-	1	-	1	-	-	3
CO3	1	-	1	3	1	-	1	2	-	2	-	1
CO4	2	-	-	1	1	-	2	1	2	2	-	1
CO5	-	-	-	1	1	-	-	-	1	1	-	2

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
I	Environmental Science	MC-I	-	-	-	0
COURSE OUTCOMES:			Domain	Level		
CO1	<i>Describe</i> the significance of natural resources and <i>explain</i> anthropogenic impacts.	Cognitive	Remember Understand			
CO2	<i>Illustrate</i> the significance of ecosystem, biodiversity and natural geo bio chemical cycles for maintaining ecological balance.	Cognitive	Understand			
CO3	<i>Identify</i> the facts, consequences, preventive measures of major pollutions and <i>recognize</i> the disaster phenomenon.	Cognitive Affective	Remember Receiving			
CO4	<i>Explain</i> the socio-economic, policy dynamics and <i>practice</i> the control measures of global issues for sustainable development.	Cognitive	Understand Analyse			
CO5	<i>Recognize</i> the impact of population and the concept of various welfare programs, and <i>apply</i> the modern technology towards environmental protection.	Cognitive Psychomotor	Understand Apply			
UNIT - I INTRODUCTION TO ENVIRONMENTAL STUDIES AND ENERGY						12
Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, flood, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.						
UNIT - II ECOSYSTEMS AND BIODIVERSITY						7
Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.						
UNIT – III ENVIRONMENTAL POLLUTION						10
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: flood, earthquake, cyclone and landslide.						
UNIT –IV SOCIAL ISSUES AND THE ENVIRONMENT						10
Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act –						

Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT –V HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education - HIV / AIDS – Women and Child welfare programme– Role of Information Technology in Environment and human health – Case studies.

LECTURE	TUTORIALS	PRACTICALS	TOTAL
45	0	-----	45

TEXT BOOKS

1. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co, USA, (2000).
2. Townsend C., Harper J and Michael Begon, Essentials of Ecology, Blackwell Science, UK, (2003).
3. Trivedi R.K and P.K.Goel, Introduction to Air pollution, Techno Science Publications, India, (2003).
4. Disaster mitigation, Preparedness, Recovery and Response, SBS Publishers & Distributors Pvt. Ltd, New Delhi, (2006).
5. Introduction to International disaster management, Butterworth Heinemann, (2006).
6. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, New Delhi, (2004).

REFERENCES

1. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media, India, (2009).
2. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, (2001).
3. S.K.Dhameja, Environmental Engineering and Management, S.K.Kataria and Sons, New Delhi, (2012).
4. Sahni, Disaster Risk Reduction in South Asia, PHI Learning, New Delhi, (2003).
5. Sundar, Disaster Management, Sarup & Sons, New Delhi, (2007).
6. G.K.Ghosh, Disaster Management, A.P.H.Publishers, New Delhi, (2006).

E RESOURCES

1. <http://www.e-booksdirectory.com/details.php?ebook=10526>
2. <https://www.free-ebooks.net/ebook/Introduction-to-Environmental-Science>
3. <https://www.free-ebooks.net/ebook/What-is-Biodiversity>
4. https://www.learner.org/courses/envsci/unit/unit_vis.php?unit=4
5. <http://bookboon.com/en/pollution-prevention-and-control-ebook>
6. <http://www.e-booksdirectory.com/details.php?ebook=8557>
7. <http://www.e-booksdirectory.com/details.php?ebook=6804>
8. <http://bookboon.com/en/atmospheric-pollution-ebook>
9. <http://www.e-booksdirectory.com/details.php?ebook=3749>
10. <http://www.e-booksdirectory.com/details.php?ebook=2604>
11. <http://www.e-booksdirectory.com/details.php?ebook=2116>
12. <http://www.e-booksdirectory.com/details.php?ebook=1026>
13. <http://www.faadooengineers.com/threads/7894-Environmental-Science>

Semester	Course name	Course Code	L	T	P	C
II	MATHEMATICS 1I (ODE & Complex Variables)	BSC 201	3	1	0	4
Course outcome					Domain	
CO1	Apply Greens theorem, Gauss divergence theorem, Stokes theorem to find area and volume using multiple integrals in Cartesian form by having simple applications involving cubes, sphere and rectangular parallelepipeds.				Cognitive	
CO2	Solve first order differential equations of different types which are solvable for p, y, x and Clairaut's type.				Cognitive	
CO3	Solve second order ordinary differential equations with variable coefficients using method of variation of parameters, Cauchy Euler equation, power series, Legendre polynomials and Bessel functions of the first kind.				Cognitive	
CO4	Use CR equations to verify analytic functions, harmonic functions, find harmonic conjugate and to find conformal mapping of translation and rotation.				Cognitive	
CO5	Apply Cauchy residue theorem to evaluate contour integrals involving sine and cosine function and to state Cauchy integral formula, Liouvilles theorem.				Cognitive	

COURSE CONTENT		Hours
UNIT I	Multivariable Calculus (Integration)	9+3
	Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	
UNIT II	First order ordinary differential equations:	9+3
	Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	
UNIT III	Ordinary differential equations of higher orders	9+3
	Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	
UNIT IV	Complex Variable – Differentiation	9+3
	Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	
UNIT V	Complex Variable – Integration	9+3
	Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral	

formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.	
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TEXT BOOKS /REFERENCE BOOKS

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. (vii)J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc- Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Semester	Course name	Course Code	L	T	P	C
II	Applied Thermodynamics	PCC-ME 201	3	1	0	4
Course outcome					Domain	
CO1	Understanding of basic fuel types and Calculation of air fuel mixtures or combustion				Cognitive	
CO2	After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.				Cognitive	
CO3	Understanding of basic principles of psychrometry and solving the problems of psychrometric chart.				Cognitive	
CO4	They will be able to understand phenomena occurring in high speed compressible flow				Cognitive	
CO5	They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.				Cognitive	

COURSE CONTENT		Hours
UNIT I		8
	Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy	
UNIT II		12
	Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis. Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties	
UNIT III		4
	Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	
UNIT IV		8
	Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser	
UNIT V		8
	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors and Analysis of steam turbines, velocity and pressure compounding of steam turbines	
TEXT BOOKS /REFERENCE BOOKS		

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.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	1	2	0	0	0	1	3	0	3	3
CO2	3	3	1	0	2	0	0	2	3	0	3	3
CO3	3	3	1	1	1	0	0	2	3	0	3	3
CO4	3	3	1	0	0	0	0	0	3	0	3	3
CO5	1	2	1	0	0	0	0	3	3	0	3	3

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
II	Fluid Mechanics And Machines	PCC-ME 202	3	1	0	4
Course outcome					Domain	
CO1	Recalling of fluids properties and understanding the equations related to fluid flow. Ability to solve problems related to momentum equation and Bernoulli's equation				Cognitive-Remembering, understanding and apply	
CO2	Understanding the concept of incompressible fluid flow fluid flow through channels and ducts. Discuss the concept of boundary layer and ability apply Darcy Weisbach equation in different condition				Cognitive-Understanding and apply	
CO3	Understanding the need and methods of dimensional analysis and ability to derive equations using dimensional analysis				Cognitive-Understanding and apply	
CO4	Explain the working of different types of pumps and ability to analyze its performance				Cognitive-Understanding analyze and apply	
CO5	Explain the working of different types of turbines and ability to analyze its performance				Cognitive-Understanding analyze and apply	

COURSE CONTENT		Hours
UNIT I	BASIC CONCEPTS AND PROPERTIES OF FLUIDS	9
	Definition of fluid, Newton's law of viscosity, Units and dimensions- Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications	
UNIT II	IN COMPRESSIBLE FLUID FLOW	9
	Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram	
UNIT III	DIMENSIONAL ANALYSIS	6
	Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis	
UNIT IV	HYDRAULIC PUMPS	8
	Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle	
UNIT V	HYDRAULIC TURBINES	8

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines

TEXT BOOKS /REFERENCE BOOKS

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 2003.
 2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
 3. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 2008.
 4. Som, S.K., and Biswas, G., “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw-Hill, 2nd Edition, 2004.
 5. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 2005.
- Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi, 2008.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	1	1	3	1	1	1	1	1	1	1
CO2	3	3	2	1	3	1	1	2	2	2	1	2
CO3	3	3	0	1	3	1	0	2	1	1	0	1
CO4	3	3	1	2	3	1	1	2	2	2	1	2
CO5	3	3	2	2	3	1	1	2	2	2	1	2
Total	15	15	6	7	15	5	4	9	10	10	4	8

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
II	Workshop/Manufacturing Practices	ESC104	1	0	3	3
Course outcome					Domain	
CO1	<i>Analyze</i> and <i>identify</i> the basic process of foundry.				Cognitive Psychomotor	
CO2	<i>List</i> the forging operations and <i>distinguish</i> hand forging with power forging.				Cognitive Psychomotor	
CO3	<i>Recall</i> the traditional metal joining processes and <i>relate</i> them with respect to the advantages and applications.				Cognitive Psychomotor	
CO4	<i>Classify</i> and <i>select</i> the suitable machining processes.				Cognitive Psychomotor	
CO5	<i>Compare</i> the types of plastics and <i>choose</i> the suitable plastic moulding processes.				Cognitive Psychomotor	

COURSE CONTENT		Hours
UNIT I	FOUNDRY	14
	Foundry – Pattern – pattern making – pattern materials – types of patterns – moulding tools – moulding sand – properties of moulding sand – moulding processes – moulding procedure – flow of molten metal in the mould.	
UNIT II	FORGING	14
	Forging and its applications – classification of forging processes – hot working, cold working, hand forging and power forging – hand forging tools – hand forging operations.	
UNIT III	WELDING	14
	Metal joining processes – welding– types of welding – gas welding-oxy acetylene welding – gas welding equipment – types of flames – electric arc welding – arc welding equipments – types of welded joints – brazing and its types.	
UNIT IV	MACHINING	14
	Lathe – working principle – description and functions of lathe parts – specification of lathe – work holding and supporting devices – speed, cutting speed, feed and depth of cut – drilling – drilling machine and its types – components of sensitive and upright drilling machine.	
UNIT V	PROCESSING OF PLASTICS	14

Plastics – types of plastics – processing of thermo plastics – extrusion, inspection blow, rotatromal moulding processes – thermo forming – processing of thermosets – compression, transfer moulding processes.

TEXT BOOKS /REFERENCE BOOKS

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”, Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

Workshop Practice:(60 hours)[L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop (10 hours)
2. Fitting shop (10 hours)
3. Carpentry (10 hours)
4. Electrical & Electronics(10 hours)
5. Welding shop (10 hours (Arc welding 5 hrs + gas welding 5 hrs)
6. Casting (8 hours)

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	3	3	2	2	-	1	-	1	2	2
CO2	3	3	3	3	2	2	-	1	-	1	2	2
CO3	3	3	3	3	2	2	-	1	-	1	2	2
CO4	3	3	3	3	2	2	-	1	-	1	2	2
CO5	3	3	3	3	2	2	-	1	-	1	2	2

Correlation level - 1 – Low 2 – Medium 3 – High

Semester	Course name	Course Code	L	T	P	C
II	Constitution of India	MC-II	-	-	-	0

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule,
Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

Semester	Course name	Course Code	L	T	P	C
III	Mathematics-III (PDE, Probability & Statistics)	BSC-301	3	1	0	4
Course outcome					Domain	
CO1	Solve homogeneous and non homogeneous linear partial differential equations of second order by complementary function and particular integral method.				cognitive	
CO2	Solve one dimensional heat equation, wave equation using separation of variables method to simple problems in Cartesian coordinates.				cognitive	
CO3	Explain conditional probability independence of events, Discrete random variables, continuous random variables, Poisson approximation to the binomial distributions and to find Marginal and conditional density functions.				cognitive	
CO4	Find statistical parameters of the Binomial, Poisson and Normal distributions and to find correlation, regression and rank correlation coefficients of two variables.				cognitive	
CO5	Apply large sample test for single proportion, difference of proportions, single mean, difference of means and to test ratio of variances, Chi square.				cognitive	

COURSE CONTENT		Hours
UNIT I		14
	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables	
UNIT II		12
	Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables	
UNIT III		12
	Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their	

	properties, distribution of sums and quotients, conditional densities, Bayes' rule.	
UNIT IV		12
	Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance:	
UNIT V		12
	Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	
TEXT BOOKS /REFERENCE BOOKS		
<ol style="list-style-type: none"> 1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. 2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. 3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint). 4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002. 		

Semester	Course name	Course Code	L	T	P	C
III	HEAT TRANSFER	PCC ME 301	3	1	0	4
Course outcome					Domain	
CO1	After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer					
CO2	The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer					
CO3	The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.					
CO4						
CO5						

COURSE CONTENT		Hours
UNIT I		6
	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number.	
UNIT II		6
	heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts	
UNIT III		8
	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	
UNIT IV		8
	Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method	
UNIT V		12
	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ϵ - NTU methods. Boiling and Condensation heat transfer, Pool boiling curve Introduction mass transfer, Similarity between heat and mass transfer	
TEXT BOOKS /REFERENCE BOOKS		

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer : A Practical Approach, McGraw Hill, 2002

Semester	Course name	Course Code	L	T	P	C
III	Strength of Materials	PCC-ME 302	3	1	0	4
Course outcome					Domain	
CO1	After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components				Cognitive	
CO2	The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading				Cognitive	
CO3	The students will be able to understand inertia and different types of springs and evaluate the different types of inertia and deflection of different types of beams with different loading conditions.				Cognitive	
CO4	The students will be able to understand torsion on shaft and springs and evaluate deflection, torsional stresses on shaft, helical spring and leaf spring				Cognitive	
CO5	After completing this course, The students will be able to understand and compute stresses in hollow cylindrical and spherical objects.				Cognitive	

COURSE CONTENT		Hours
UNIT I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	8
	Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle	
UNIT II	BEAMS - LOADS AND STRESSES	8
	Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads	
UNIT III	DEFLECTION OF BEAMS	8
	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems	
UNIT IV	TORSION AND SHAFTS	8
	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs	
UNIT V	ANALYSIS OF STRESSES IN TWO DIMENSIONS	8
	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure	
TEXT BOOKS /REFERENCE BOOKS		

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Beer, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	2	3	3	1	2	1	2	1	2	3
CO2	3	3	2	3	3	1	2	1	2	1	3	3
CO3	3	3	2	3	3	1	2	1	2	1	2	3
CO4	3	3	2	3	3	1	2	1	2	1	2	3
CO5	3	3	2	3	3	1	2	1	2	1	3	3

Correlation level - 1 – Low 2 – Medium 3 – High

PCC-ME 303	Mechanical Engineering Laboratory (Thermal) I	0L:0T:3P	1.5 credits
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Objectives:

- (i) To understand the principles and performance characteristics of flow and thermal devices
- (ii) To know about the measurement of the fluid properties

Contents:

1. Measurement of Coefficient of Discharge of given Orifice and Venturi meters
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine
7. Determination of the thermal conductivity and specific heat of given objects
8. Determination of the calorific value of a given fuel and its flash & fire points
9. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
10. Determination of the convective heat transfer coefficient for flow over a heated plate
11. Determination of the emissivity of a given sample
12. Determination of the performance characteristics of a vapour compression system

Course Outcomes:

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery

Semester	Course name	Course Code	L	T	P	C
IV	Instrumentation and Control	PCC-ME 401	3	1	0	4

COURSE CONTENT		Hours
UNIT I		
	Measurement systems and performance – accuracy, range, resolution, error sources.	
UNIT II		
	Instrumentation system elements – sensors for common engineering measurements; Signal processing and conditioning; correction elements-actuators: pneumatic, hydraulic, electric.	
UNIT III		
	Control systems – basic elements, open/closed loop, design of block diagram; control method P, PI, PID, when to choose what, tuning of controllers.	
UNIT IV		
	System models, transfer function and system response, frequency response; Nyquist diagrams and their use.	
UNIT V		
	Practical group based project utilizing above concepts.	

TEXT BOOKS /REFERENCE BOOKS

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 200
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V , Mechanical Measurements (6th Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York,1999.

Semester	Course name	Course Code	L	T	P	C
IV	Kinematics & Theory of Machines	PCC-ME 402	3	1	0	4

COURSE CONTENT		Hours
UNIT I		8+4
	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	
UNIT II		8+2
	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation	
UNIT III		8+2
	Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	
UNIT IV		8+2
	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics	
UNIT V		8+2
	Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes	
TEXT BOOKS /REFERENCE BOOKS		
<ol style="list-style-type: none"> 1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005. 2. Cleghorn W.L. , Mechanisms of Machines, Oxford University Press, 2005. 3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009. 4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi, 1988. 		

Semester	Course name	Course Code	L	T	P	C
IV	Solid Mechanics	PCC-ME 403	3	1	0	4
COURSE CONTENT						Hours
UNIT I						
	Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress:					
UNIT II						
	Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions					
UNIT III						
	Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition.					
UNIT IV						
	Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration problems, thermo-elasticity, 2-d contact problems					
UNIT V						
	Solutions using potentials. Energy methods. Introduction to plasticity.					
TEXT BOOKS /REFERENCE BOOKS						
<p>[1] G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.</p> <p>[2] Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.</p> <p>[3] Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.</p>						

PCC-ME 404	Mechanical Engineering Laboratory (Design) II	0L:0T:3P	1.5 credits
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Objectives:

- (i) To understand the measurement of mechanical properties of materials
- (ii) To understand the deformation behaviour of materials
- (iii) To understand the kinematic and dynamic characteristics of mechanical devices

Contents

1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinnell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Strain measurement using Rosette strain gauge
7. Microscopic examination of heat-treated and untreated metallic samples
8. Velocity ratios of simple, compound, epicyclic and differential gear trains
9. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
10. Cam & follower and motion studies
11. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient
12. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies