Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded

Department of Production Engineering

Syllabus- (S.Y.)

B. Tech Production Engineering

From 2019-20

Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded S.Y. B. Tech. Department of Production Engineering.

From Academic Year 2019-20

Program Educational Objectives (PEOs):

PEO-1 Provide knowledge and skills of broad spectrum of manufacturing processes.

PEO-2 Develop capabilities of Product Design and Analysis through learning opportunities to work with up-to-date platforms in CAD/CAM/CAE.

PEO-3 Provides students with requisite philosophies, tools and techniques of operations management for becoming key players in any business organization.

PEO-4 Encourage students to acquire knowledge application aptitude for basic sciences, environmental issues, analytical abilities, self-initiated learning, out of box thinking, soft skills, professional skills, leadership qualities and work in team

PEO-5 Develop / Provide foundation for taking up a higher studies, entrepreneurship and administrative services in India and abroad.

Program Outcomes (POs) & Program Specific Outcomes (PSOs):

Program Outcomes:

Engineering Graduates will be able to:

a. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. **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.

e. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. **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.

g. **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.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k. **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.

l. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:

The Production engineering curriculum prepares gradates to:

PSO-1 Apply principles of engineering, basic science and mathematics to model, analyze, design production systems and processes.

PSO-2 Plan, operate, control, maintain and improve production systems, components and processes.

PSO-3 Be prepared to work professionally as production/mechanical engineer.

Correlation Matrix (Correlation between the PEOs and the POs)

PO/PSO ➡ ⬇ PEO	a	b	c	d	e	f	g	h	i	J	k	l	PSO 1	PSO 2	PSO 3
I	√		√	√								√	√	√	√
II			√	√	√							√	√	√	√
III			√	√					√		√		√		√
IV						√		√	√	√	√	√			√
V						√	√	√	√	√	√	√			√

Note: The cells filled in with ✓ indicate the fulfillment/correlation of the concerned PEO with the PO.

Structure of curriculum:

Semester I						
Course Code	**Name of the course**	**L**	**T**	**P**	**Credits**	
					Th	**Pr**
BSC271	Mathematics-III: Transform Calculus and Differential Equations	3	--	--	3	--
PCC-PE201	Strength of Materials	3	--	2	3	1
PCC-PE202	Thermal Engineering- I	4	--	2	4	1
PCC-PE203	Casting and Welding	3	--	2	3	1
PCC-PE204	Engineering Metallurgy	3	--	2	3	1
PCC-PE205	Machine Drawing and CADD	2	--	2	2	1
BSC261	Mathematical Foundation for Engineering*	2	--	--	Audit	
MAC277	Indian Constitution	2	--	--	Audit	
	Total	**22**	--	**10**	**23**	
Semester II						
Course Code	**Name of the course**	**L**	**T**	**P**	**Credits**	
					Th	**Pr**
BSC274	Mathematics-IV: Statistical and Numerical Methods	3	--	--	3	--
PCC-PE206	Theory of Machines	4	--	2	4	1
PCC-PE207	Thermal Engineering- II	3	--	2	3	1
PCC-PE208	Mechanical Measurement and Metrology	3	--	2	3	1
PCC-PE209	Machining Processes	3	--	--	3	--
LAB-PE210	Manufacturing Lab - I	--	--	2	--	1
HMC278	Human Values and Professional Ethics	2	--	--	2	--
	Total	**18**	--	**8**	**22**	

L – No. of Lecture Hours/week, T – No. of Tutorial Hours/week, P – No. of Practical Hours/week

* This Audit course is only for Direct Second Year students and a MANDATORY course.

STRENGTH OF MATERIALS

(L-03, T-00, P-02, CREDITS TH.-03, P-01)

Course Code: PCC-PE201

Course Objectives:

Objective 1. To understand the fundamental concepts of strength of materials.

Objective 2. To predict behavior of material under different loading conditions.

Objective 3. To study the factors affecting the design of a mechanical component.

Objective 4. To apply fundamental concepts and knowledge of the course for real life applications.

Course Outcomes:

On successful completion of this course, students should be able to;

PCC-PE-201.1 Define, compute and describe stress, strain and properties of engineering material, their behavior.

PCC-PE-201.2 Compute stresses and strains using analytical and graphical methods.

PCC-PE-201.3 Describe critical loads, buckling of beams and strain energy of components, torsion of shafts and thin cylinder.

PCC-PE-201.4 Analyze beams and columns under different loading and supporting conditions.

Articulation Matrix

	Name of Course	**PO**			**PSO**		
		1	**2**	**3**	**1**	**2**	**3**
PCC-PE-201	Strength of Materials	1	3	1	2		3
PCC-PE201.1	Define, compute and describe properties of engineering material, their behavior.	1					
PCC-PE201.2	Compute stresses and strains using analytical and graphical methods.		3		2		3
PCC-PE201.3	Demonstrate the knowledge of critical loads, buckling of beams, strain energy and torsion for simple problems.			1			
PCC-PE201.4	Analyze beams and columns under different loading and supporting conditions.		3				3

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**SIMPLE STRESSES AND STRAIN** Types of loads, Simple stresses & strains, viz. tensile, compressive, Shear, Crushing, Thermal stresses, Hoop stresses & corresponding strains, Volumetric Strain, Bulk modulus, Hook's law, Young's modulus, Modulus of Rigidity, stress-strain curves for ductile & brittle materials, Poisson's ratio.	**CO1/ CO2**	**06**
02	**MOHR'S CIRCLE FOR PLANE STRESS AND PLANE STRAIN** Definition of principal plane & principal stresses, Expression for normal and tangential stress, maximum shear stress, Stresses on inclined planes, Position of principal planes & planes of maximum shear, Graphical solution using Mohr's circle	**CO1/ CO2**	**06**
03	**SHEAR FORCE AND BENDING MOMENT DIAGRAMS, BENDING AND SHEAR STRESSES** Shear force, bending moment & relation between them, Shear force & bending moment diagrams of Stranded Cases, concept different load & couples acting on beam, Location of point of contra-flexure. Theory of simple bending, equation of bending, Assumptions in the theory of bending, moment of resistance, section modulus & neutral axis, Shear stresses – concepts of direct & transverse shear stress, flitch beam	**CO2/ CO3**	**10**
04	**DEFLECTION OF BEAMS, AND COLUMNS** Concepts of Deflection of beams – relation between bending moment & slope, Deflection of simply supported beams and cantilever beams subjected to point load. Concepts of Buckling – Rankine's & Euler's formulae for buckling load for columns / shafts under compression,	**CO4**	**10**

	concepts of equivalent length for various end conditions.		
05	**TORSION** Concept of Pure Torsion, Torsion equation for solid and hollow circular shafts, Assumptions in theory of pure Torsion, Comparison between Solid and Hollow Shafts subjected to pure torsion	**CO2 /CO3**	**07**
06	**STRAIN ENERGY AND THIN CYLINDERS** Concept, derivation & use of expression for deformation of axially loaded members under gradual, sudden & impact load, Strain energy due to self-weight. Concept of stresses & strains in thin cylindrical & spherical shells subjected to internal pressure.	**CO1 /CO3**	**06**

Term Work:

The term work shall consist of assignments on the syllabus and the following laboratory tests on the mechanical properties of material.

1. Tension test on ductile material.
2. Bending test on different materials like steel, aluminum.
3. Shear test.
4. Torsion test.
5. Hardness test.
6. Impact test.

Text and Reference Books:

1. R. Ramamrutham, Strength of Materials, 14th Edition, Dhanpat Rai Publications, New Delhi.
2. F. L. Singer and A. Pytel, Strength of Materials, 3rd Ed., Harper & row Publishers, New York.
3. Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill, New Delhi
4. Dr.R.K.Bansal, Strength of Materials, 5th Edition, Laxmi Publications-New Delhi
5. R. L. Mott, Applied Strength of Materials, 4th Ed., Prentice Hall of India, New Delhi
6. E. Popov, Mechanics of Materials, Prentice Hall of India, New Delhi

THERMAL ENGINEERING - I

(L-04, T-00, P- 02, CREDITS TH.-04, P-01)

Course Code: PCC-PE202

Course Objectives:

Objective 1. To study fundamental laws of thermodynamics, thermodynamics devices and its applications.

Objective 2. To get conversant with steam engineering.

Objective 3. To understand the structure and performance of I.C. Engine

Course Outcomes:

On successful completion of this course, students should be able to;

PCC-PE-202.1. Describe fundamentals of thermodynamics, thermodynamic devices and their applications.

PCC-PE-202.2. Spectacle the knowledge in the field of steam engineering.

PCC-PE-202.3. Evaluate the performance of I.C. Engine.

PCC-PE-202.4. Identify the thermodynamics devices required in different thermal engineering applications

Articulation Matrix

	Name of Course	**PO**			**PSO**			
		1	**2**	**3**	**4**	**1**	**2**	**3**
PCC-PE-202	Thermal Engineering- I	1	3	1	2	2	1	2
PCC-PE202.1	Describe fundamentals of thermodynamics and their applications.	1						
PCC-PE202.2	Demonstrate the knowledge in the field of steam engineering.				2		1	
PCC-PE202.3	Evaluate the performance of I.C. Engine.		3	1		2		2
PCC-PE202.4	Identify the thermodynamics devices required in different thermal engineering applications.						1	

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**FUNDAMENTALS OF THERMODYNAMICS:** Macroscopic and microscopic approach, thermodynamics systems, properties, point function and path function, process and cycle, thermodynamic equilibrium, quasi-static process, , work and heat transfer, P-dV and other types of work, temperature, Zeroth law of thermodynamics, principle of temperature measurement and various instruments, specific heat, **The First Law of Thermodynamics:** Joule's experiment, statement of the First law of thermodynamics for a cyclic and non-cyclic process, stored energy, perpetual motion machine of the first kind (PMM-I), energy balance in steady flow, some steady-flow devices…. (Numericals)	**CO1**	**08**
02	**THE SECOND LAW OF THERMODYNAMICS:** Limitations of the first law of thermodynamics, thermal reservoir, heat engine, refrigerator, heat pump, statements of the second law of thermodynamics, perpetual motion machine of the second type (PMM-II), reversible process, irreversible processes, Carnot cycle, reversed Carnot cycle, **Entropy:** Clausius inequality, change of entropy in a reversible process, T-S diagram, the increase-in- entropy principle, physical significance of entropy, T-dS relations, third law of thermodynamics. (Numericals)	**CO1**	**06**
03	**STEAM:** Formation of steam, properties of steam, P-V-T surface, critical point and triple point, t-s and h-s diagrams, enthalpy change during formation of steam, wet steam, superheated steam, specific volume of steam, entropy of steam, internal energy of steam, use of steam tables, Boilers: types of boilers, some industrial boilers, high-pressure boilers, performance of boilers, boiler mountings and boiler accessories. (Numericals)	**CO1 /CO4**	**06**
	NOZZLE AND CONDENSER: Types of steam nozzle, steam flow through		

04	a nozzle, supersaturated expansion of steam, steam condenser, functions of a condenser, elements of a condensing plant, types of condensers, jet condenser, surface condenser, estimation of cooling water required, condenser efficiency, analysis of condenser operation, air extraction, cooling towers, cooling ponds.	**CO4**	**08**
05	**AIR STANDARD CYCLES:** Air Standard cycles, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle. (Numericals)	**CO2**	**06**
06	**INTERNAL COMBUSTION ENGINE:** Classification of IC engines, components of engines, petrol engines, diesel engines, comparison between petrol and diesel engines, comparison between two-stroke and four-stroke engines, advantages and disadvantages of two-stroke and four stroke cycle engines, air–fuel mixture, carburetion, fuel-injection system, governing of I.C. engines, ignition systems, firing order, engine-cooling systems, engine lubrication systems, efficiencies, supercharging, performance of internal combustion engines and heat balance sheet,. (Numericals)	**CO3**	**10**

Term Work:

Part-I: Laboratory work

Conduct of following laboratory experiments

1. Study of Components of IC Engine.
2. Study of Valve timing diagram
3. Trial on Single cylinder Four stroke diesel engine.
4. Trial on three/four cylinder four stroke petrol engine.
5. Determination of properties of lubricating oil such as flash and fire point of lubricating oil, etc.
6. Trial on separating and throttling calorimeter.
7. Study of different condensers.
8. Study of different types of boilers.
9. Study of boiler mountings and accessories.

Part-II: Assignments

Record of at least six assignments preferably based on latest development in a particular field based on above syllabus.

Practical Examination:

Practical examination consists of viva-voce/oral by external/internal examiner.

Reference Books:

1. M. M. Rathore, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. B. K. Sarkar, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. P. K. Nag, 'Engineering Thermodynamics', Tata McGraw Hill Publishing Company Ltd. New Delhi.
4. Yunus A. Cengel, Michael A. Boles, "Thermodynamics: An Engineering Approach", Mcgraw-Hill College; 4th edition.
5. R. K. Rajput, 'Thermal Engineering', Laxmi Publications Pvt. Ltd, New Delhi
6. J. Selwin Rajadurai, 'Thermodynamics and Thermal Engineering', New Age InternationalPublishers, New Delhi
7. P. L Ballany, 'Thermal Engineering', Khanna Publishers, New Delhi.

CASTING AND WELDING

(L-03, T-00, P-02, CREDITS TH.-03, P-01)

Course Code: PCC-PE203

Course Objectives:

Objective 1. To understand the fundamentals and principles of casting and welding.

Objective 2. To understand the various machinery and equipment required to perform the welding operations.

Objective 3. To understand and apprehend various applications of the casting processes

Course Outcomes:

On successful completion of this course, students should be able to:

PCC-PE-203.1. Select materials, types and allowances of patterns used in casting and analyze the components of moulds.

PCC-PE-203.2. Understand arc, gas, and resistance welding processes and their different types

PCC-PE-203.3. Design core, core print and gating system in metal casting processes

Articulation Matrix

	Name of Course	PO						PSO		
		1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
PCC-PE-203	Casting and Welding	1	2	1		2	1	2	2	2
PCC-PE-203.1	Select materials, types and allowances of patterns used in casting and analyze the components of moulds.	1						1		1
PCC-PE-203.2	Describe and compare arc, gas, and resistance welding processes.			1				2		2
PCC-PE-203.3	Design core, core print and gating system in metal casting processes.		2			2	1	2	2	2

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**CASTING** **Introduction to casting processes:** Classification, advantages, limitations, applications of casting, casting terms, sand mold making procedure **Technology of patternmaking, moulding and coremaking:** Pattern materials, pattern making tools, types of patterns, pattern allowances, methods of constructing patterns, color coding, Tools and equipment's, types of modeling sands, sand additives, properties of molding sand and testing, molding processes: green sand, dry sand molding: advantages, limitations and applications Core materials, core prints, core boxes, core making, and chaplets.	**CO1**	**10**

02	**SPECIAL CASTING PROCESSES:** Shell molding, investment molding, Full molding process, CO2 molding, permanent mold casting, die casting, centrifugal casting and continuous casting, advantages, limitations and applications.	**CO1**	**05**
03	**MELTING, POURING AND FEEDING:** Introduction of Furnaces for ferrous and non-ferrous casting E.g. Copula: use, construction, charging and other furnaces. **Gating and risering of castings:** Gating system, gates, gating ratio, casting yield, and gating system design, Risering of casting, function, shape, types, location, feeding distance, and its design parameters	**CO3**	**05**
04	**DESIGN CONSIDERATIONS AND INSPECTION OF CASTING:** Designing for economical molding and eliminating defects, Defects in casting, inspection methods: visual, dimensional, mechanical, metallurgical and NDT.	**CO1**	**04**
05	**WELDING:** Introduction, weldability, metal properties and its significance in welding, Classification of welding processes, applications and need of welding processes **Metal arc welding:** Introduction, welding procedure, accessories, power supplies in arc welding, flux, factors of arc welding, electrodes, coding, weld nomenclature, types of joints, positions of welding, weld defects, causes and remedies D&NDT of welds, design of weld joints,	**CO2**	**10**
06	**TYPES OF ARC WELDING PROCESSES:** Principle, working, advantages, limitations and applications of carbon arc, submerged arc, electro slag, electro-gas, flux-cored arc welding and plasma arc welding, **Gas welding:** Types of flames, equipment, working, applications of gas welding, MIG, TIG, Oxy-acetylene cutting, arc cutting	**CO2**	**10**
07	**RESISTANCE WELDING:** Introduction, 4-period welding, types like Butt, Spot, Seam, flash, stud, Projection, Percussion, and Thermit welding.	**CO2**	**04**

Term Work:

The term work shall consist of a journal record based on above syllabus and one –two jobs on pattern making and welding.

Practical Examination (4hrs):

It shall consist of preparation of two jobs out of the following:

1. Pattern making.
2. Mould making.
3. Arc welding.
4. Gas welding.

And an oral based on the term work prescribed above and job prepared.

Weightage:

Casting 50% Welding 50%

Reference Books:

1. Heine R.W, Loper C.R and Rosenthal P.C , "Principles of metal casting", Tata McGraw Hill Publication Co.1998
2. P. L. Jain , "Principles of foundry technology", Tata McGraw Hill Education , New Delhi, 2003
3. P N Rao , "Manufacturing Technology-Foundry, Forming and welding", Tata McGraw Hill, New Delhi , 2006
4. Richard. Little, "Welding Technology", Tata McGraw Hill Pub. New Delhi
5. Dr. Y.V Deshmukh P.K. Roy , "Welding Manufacturing Process",CBS Publisher and Distributers , New Delhi , 1984

ENGINEERING METALLURGY

(L-03, T-00, P-02, CREDITS TH-03, P-01)

Course Code: PCC-PE204

Course Objectives:

Objective 1. The main objective of this subject is to make student aware of methods of manufacturing Pig Iron from Iron ore and making of steel by Basic oxygen and Electric arc melting processes

Objective 2. The study of phase diagrams of ferrous and non-ferrous metals alloys help students to understand how to make various engineering alloys and modify their structures and properties by heat treatments to suit a particular application.

Objective 3. Study of concept of powder metallurgy helps to make use of difficult to melt metals in making and shaping of various component shapes for engineering applications.

Objective 4. Study of different composite materials and its application in manufacturing processes.

Objective 5. Study of different nondestructive testing methods for inspecting the components

Course Outcomes:

On successful completion of this course, students should be able to:

PCC-PE-204.1. Identify the methods of Manufacturing of steel and phase diagram. Interpret Iron –Iron carbide equilibrium diagram, time Temperature transformation (TTT) diagrams and their significance.

PCC-PE-204.2. Classify the cast irons and their applications and heat treatment processes.

PCC-PE-204.3. Select suitable heat-treatment process to achieve desired properties of steel by acquiring the fundamentals of heat treatment.

PCC-PE-204.4. Differentiate engineering nonferrous materials and its applications.

PCC-PE-204.5. Describe powder metallurgy, its processes and applications.

PCC-PE-204.6. Choose the composite materials and its application in manufacturing processes.

PCC-PE-204.7. Select the suitable nondestructive testing method for inspecting components.

Articulation Matrix

	Name of Course	**PO**						**PSO**		
		1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
PCC-PE-204	Engineering Metallurgy	1	2		2	2		2	1	2
PCC-PE-204.1	Identify the methods of manufacturing of iron and steel.	3								2
PCC-PE-204.2	Interpret significance of Iron –Iron carbide equilibrium diagram, time Temperature transformation (TTT) diagrams and powder metallurgy.				3			1		
PCC-PE-204.3	Classify the various metals alloys and composite materials and their applications and heat treatment processes.	2					2		1	
PCC-PE-204.4	Evaluate a metal alloy or material for a practical case.						2			2

	Name of Course	PO						PSO		
		1	2	3	4	5	6	1	2	3
PCC-PE-204.5	Select the suitable non-destructive testing method for inspecting components.				2					1

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**INTRODUCTION:** Pig iron Production, Manufacture of steel, by Basic oxygen steel making, Electric Arc steel making, introduction to phase diagram	**CO1**	**06**
02	**STEEL AS AN ENGINEERING ALLOY:** Iron –Iron carbide equilibrium diagram, non-equilibrium cooling of steels, classification and applications of steel, specifications of steel, transformation products of austenite, time Temperature transformation (TTT) diagrams, Austenite and ferritic grain size in steels.	**CO1**	**06**
03	**CAST IRONS**: White C.I. Gray C.I. malleable C.I., Nodular cast iron, Alloy cast irons and heat treatment of cast irons.	**CO2**	**10**
04	**HEAT TREATMENT OF STEEL:** Conventional annealing, Bright annealing, box annealing, Isothermal (cycle) annealing, Spheroidised annealing, Subcritical annealing, Normalizing, Hardening, Retention of austenite, Effect of retained austenite, elimination of retained austenite, Tempering, Secondary hardening, Temper brittleness, Quench cracks, Hardenability, Carburizing, Selective carburizing, heat treatment after carburizing,	**CO2**	**10**

	Nitriding, Carbonitriding, flame hardening, Induction hardening.	**/CO3**	
05	**ENGINEERING NON-FERROUS METALS:** Copper and copper alloys, Brasses, Aluminum and Aluminum alloys, Nickel and Nickel alloys, Tin and tin alloys and Bearing materials	**CO4**	**07**
06	**POWDER METALLURGY:** Introduction, characterization and testing of metal powders, powder manufacture, powder conditioning, Oil impregnated bearings, cemented carbide, cermet, advantages and limitations of powder metallurgy.	**CO5**	**06**
07	**COMPOSITE MATERIALS AND ITS APPLICATION:** Different composite materials and its application in manufacturing processes.	**CO6**	**03**
08	**STUDY OF NON-DESTRUCTIVE METHODS**: Dye penetrant test, Magnetic particle test, Ultrasonic test, Radiography, Eddy current test, significance &comparison of these tests.	**CO7**	**03**

Term Work:

The term - work shall consist of a journal based on the below mentioned laboratory Experiments/study (at least 8).

1. Study of Metallurgical Microscope.
2. Preparation of Specimen for microscopic examination.
3. Heat Treatment of PCS and determine change in percentage of hardness and grain structure.
4. Study of microstructure of plain carbon steels of various compositions.
5. Study of microstructure of various types of C.I.
6. Jominy end-quench test for hardenability.
7. Study of microstructure of various types of alloy steels.
8. Study of microstructure of non – ferrous metals and their alloys.
9. Surface hardening and study of microstructure (study expt.)
10. Study of I.S. codes of steels and selection procedure.
11. Study and demonstration of the NDT processes.

References Books:

1. Guy Albert G.,"Elements of Physical Metallurgy", Oxford & IBH Publishing Co., New Delhi, 1974.
2. Swarup O.,"Elements and Metallurgy",Rastogi Publication,Meerut,1983.
3. Naik S.P.,"Engineering Metallurgy and Material Science",Charotar Publication House,New Delhi, 1985.
4. Jain R.K.,"Production Technology",Khanna Publication,New Delhi, 1986.
5. Higgins Raymond A."Engineering Metallurgy Part-I Metallurgy Process Technology", ELBS,New Delhi, 1987.
6. Kodgire V. D., "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 2008, ISBN 81-86314-00-8.
7. Khanna O.P. "Materials Science and Metallurgy", Dhanpat Rai & Sons, New Delhi, 2010, ISBN-97-88189-92-831-5.
8. William D. Callister,"Materials Science and Engineering: An Itroduction, 8th Edition, Wiley India (P) Ltd (2010).
9. Raghavan V," Physical metallurgy principles and practice", PHI Learning Privat Limited, New Delhi,2012,ISBN-9788120330122
10. Sidney H. Avner,"Introduction to Physical Metallurgy", Tata McGraw-Hill Education, 2013,ISBN-9780074630068
11. T.V. Rajan, C.P. Sharma," Heat Treatment principles and Techniques", PHI Learning Pvt. Ltd., 1994.

MACHINE DRAWING AND CADD

(L-02, T-00, P-02, CREDITS TH.-02, P-01)

Course Code: PCC-PE205

Course Objectives:

Objective 1. To learn ISO standards used in machine drawing.

Objective 2. To learn the conventions displayed on a product drawings.

Objective 3. To learn drawing and documentation.

Objective 4. To gain knowledge of various machine parts and their applications.

Objective 5. To use Sketcher, modeling, assembly and drafting in CAD software like AutoCAD, Solid edge/Solid works/NX/CATIA/Creo for machine drawing.

Course Outcomes:

On successful completion of this course, students should be able to:

PCC-PE-205.1. Acquire knowledge of various ISO standards used in machine drawing and apply those.

PCC-PE-205.2. Read and interpret the conventions displayed on a product drawing.

PCC-PE-205.3. Use the important entities like Limits, Fits, Tolerances and Surface Finish, towardstheir use in the drawing.

PCC-PE-205.4. Identify and draw various machine parts.

PCC-PE-205.5. Draw/model parts and assemblies using CAD software.

Articulation Matrix

	Name of Course	**PO**					**PSO**		
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**
PCC-PE-205	Machine Drawing and CADD	1				3	1	2	3
PCC-PE-205.1	Describe ISO standards used in machine drawing and apply those.						1		1
PCC-PE-205.2	Interpret the conventions displayed on a product drawing.								
PCC-PE-205.3	Construct machine drawing using important entities like Limits, Fits, Tolerances and Surface Finish.							2	3
PCC-PE-205.4	Identify and draw various machine parts.	1						1	
PCC-PE-205.5	Draw/model parts and assemblies using CAD software.					3	1		3

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**INTRODUCTION TO MACHINE DRAWING AND CADD:** Machine drawing, CAD concept, software and hardware, CADD, Drawing Standards	CO 01	04
02	**BUREAU OF INDIAN STANDARDS (BIS) CONVENTIONS AND CONVENTIONAL REPRESENTATION:** General principles and convention of engineering/machine drawing: Use of Indian and International standards; IS/ISO codes; Surface Finish, Welded Joints, Riveted Joints: Single and Double Riveted Butt and Lap Joints, Engineering curves (Involutes, cycloidal family of curves, helix and spiral); Spur gear, helical gear, Bevel gear and Worm and Worm Wheel and Thread Profiles; Conventions/symbols for process flow, electrical and instrumentation units	CO 01/ CO 02	06
03	**COMPUTER AIDED DRAFTING AND DOCUMENTATION:** Introduction to CAD, CAD software and hardware, Study of 2D and 3D modeling software, Sketching in CAD, Commands for geometry creation, editing, viewing, printing; Use of templates and layers; Introduction to solid and assembly modeling; import and export of CAD data; Automated drafting in Solid modeling software;	CO 05	08
04	**MACHINE PARTS:** Screwed Fastenings; Pipe Joints, Riveted joints, cotter and knuckle joints, keys, shafts, couplings, valves	CO 04	04
05	**PRODUCTION DRAWINGS AND BLUE PRINT READING:** Assembly and detail drawing with complete dimensioning, tolerancing, materials and surface finish, Assembly and part drawings including detailed documentation i. e. dimensioning, tolerancing, materials and surface finish, study and preparation of bill of materials; Blue print reading,	CO 04 /CO 05	08

Term Work:

The term work shall consist of preparation of drawings related to above syllabus using sketchbook, drawing sheets and CAD tools

Text Books:

1. Machine Drawing -N.D. Bhatt & V.M. Panchal, 46th Edition Charotar Publishing House, 2011
2. Machine Drawing –Siddheswar, Kannaiyah, and Shastry 37th Edition, Tata Mc-graw hill publication New Delhi 2009.
3. Machine Drawing with AutoCAD – G. Pohit and G. Ghosh, Pearson Education, 2005
4. Machine Drawing includes AutoCAD- Ajeet Singh, 2nd Edition Tata Mc-graw hill publication New Delhi 2012.

Reference Books:

1. Machine drawing, K. C. John, PHI
2. James Bethune, Engineering graphics, Pearson Education
3. P.S. Gill, Machine Drawing - S. K. Kataria and Sons, Delhi, 2002
4. Narayana KL, Kannaiah P, Venkata Reddy K, Machine Drawing, 2nd Edition, New Age International, 2009
5. Dhawan R. K, A text book of Machine Drawing, S. Chand & Co, New Delhi, 2005
6. Junnarkar ND, Machine Drawing, Pearson Education, 2005
7. Radhakrishnan, CAD/CAM/CIM, New Age International Publication, 2003

MATHEMATICAL FOUNDATION FOR ENGINEERING

(L-02, T-00, P-00, (mandatory Audit Course for DSE))

Course Code: BSC261

Course Objectives:

1. To develop the sound conceptual understanding of Algebra, coordinate geometry, complex numbers , vectors, matrices, Calculus and Differential Equations.
2. To develop the foundation for engineering mathematics and other engineering courses.

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

CO1	analyze the structure of complex numbers, quadratic equations, vectors and matrices and their uses.
CO2	Find the standard and general equations of lines, circles, conic sections, and their properties.

CO3	Sketch the graphs of functions and can evaluate limit, continuity, derivatives, integrations.
CO4	Formulate and solve first order differential equations.

Articulation Matrix

PO → / CO ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	2								2
CO2	3	3	1	2								1
CO3	3	3										1
CO4	3	3	2									2

Note: 1-Low, 2-Medium or 3- High.

Unit-1 Complex Numbers (05 hours)

Complex numbers as ordered pairs. Argand's diagram. Triangle inequality. Powers and roots of complex numbers, De Moivre's Theorem.

Unit-2 Algebra (05 hours)

Quadratic equations and express-ions. Permutations and Combinations. Binomial theorem for a positive integral index.

Unit-3 Coordinate Geometry (07 hours)

Coordinate Geometry: Locus. Straight lines. Equations of circle, parabola, ellipse and hyperbola in standard forms. Parametric representation.

Unit-4 Vectors and Matrices (08 hours)

Addition of vectors. Multiplication by a scalar. Scalar product, cross product and scalar triple product with geometrical applications. Matrices and Determinants: Algebra of matrices. Determinants and their properties. Inverse of a matrix. Cramer's rule.

Unit-5 Differential Calculus (10 hours)

Function. Inverse function. Elementary functions and their graphs. Limit. Continuity. Derivative and its geometrical significance. Differentiability. Rules of derivatives, Applications of Derivatives: Tangents and Normals, Increasing and decreasing functions. Maxima and Minima

Unit-6 Integral calculus (10 hours)

Integration as the inverse process of differentiation. Integration by parts and by substitution. Definite integral and its application to the determination of areas (simple cases). Solving first order differential equations:Exact differential equations and first order linear differential equations.

References:

1. Bernard and Child, Higher Algebra, Macmillan and Co. Pvt. Ltd, New York.
2. J.V. Uspensky, Theory of equations, macGraw Hill Publications.
3. S. L. Loney, The Elements of Coordinate Geometry, Macmilliams and Co., New York
4. G.B.Thomas, M.D.Weir, J. Hass, Thomas' calculus, 12th edition, Pearson Publications
5. H.Anton, C. Rorrers, Elementary Linear Algebra Applications version, 9th edition, Wiley publications.

INDIAN CONSTITUTION

(L-02, T-00, P-00, C -00 (mandatory Audit Course))

Course Code: MAC277

Course Objectives:

Objective 1. To understand the basic foundation and the basic law for the governance of our nation, the history and the different types of Constitutions.

Objective 2. To understanding the importance and the different aspects of the Constitution. To know and understand the different rights enshrined in the Constitution and understand the rights and duties of the government.

Objective 3. To understand the basis and procedure of amendments.

Objective 4. To know the different aspects of the Union and the State Executive.

Objective 5. To know how our country was founded, who founded it, what are our rights are, what life was like, how life has changed, how the rights still apply today.

Course Outcomes:

MAC-277.1. Student will be able to understand how India has come up with a Constitution which is the combination of the positive aspects of other Constitutions.

MAC-277.2. Student will be able to understand the interpretation of the Preamble.

MAC-277.3. Student will be able to understand the basics of governance of our nation.

MAC-277.4. It helps in understanding the different aspects covered under the different important Articles.

MAC-277.5. Student will be able to understand the basic law and its interpretation. Understand the important amendments which took place and their effects.

MAC-277.6. Student will be able to understand our Union and State Executive better.

MAC-277.7. Student will be able to that along with enjoying the rights one needs to fulfill one's duties.

Course Contents

1.	Meaning of the constitution law and constitutionalism. Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India
2.	Scheme of the fundamental rights. The scheme of the Fundamental Duties and its legal status
3.	The Directive Principles of State Policy –Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and States.
4.	Parliamentary form of Government in India. The constitution powers and status of the President of India.
5.	Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.

6.	Emergency Provisions: National Emergency, President Rule, Financial Emergency.
7.	Local Self Government – Constitutional Scheme in India.
8.	Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19. Scope of the Right to Life and Personal Liberty under Article 21.

Text Books:

1. Introduction to the Constitution of India by Durga Das Basu (Students Edn.) Prentice-Hall EEE, 19th /20th Edition, 2001.
2. An Introduction to Constitution of India by M. V. Pylee, Vikas Publishing, 2002.

MATHEMATICS-III: Transform Calculus and Differential Equations

(L-03, T-00, P-00, CREDITS TH.-03, P-00)

Course Code: BSC271

Course Objectives:

Objective 1. To understand the concepts of Laplace transforms, Fourier Series, Fourier transforms

Objective 2. To apply Laplace transforms for solving ordinary differential equations

Objective 3. Define and compute the line integral, surface integral, volume integral using Green's Theorem, Stokes's Theorem and the Divergence Theorem.

Objective 4. To understand the methods of solving partial differential equations such as wave equation, heat equation and Laplace equation.

Course Outcomes:

On successful completion of this course students will be able to

BSC 271.1. Develop the skills of Laplace transforms, Fourier series and Fourier transforms and their inverses.

BSC 271.2. Develop the skills of solving Partial differential equations

BSC 271.3. Solve ODE's and PDE's using the properties of Laplace transform, Fourier series and Fourier Transforms.

BSC 271.4. Determine solutions of PDE for vibrating string and heat conduction.

BSC 271.5. Evaluate line integrals, surface integrals, and volume integrals and convert line integrals into area integrals and surface integrals into volume integrals using integral theorems

Articulation Matrix

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

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**LAPLACE TRANSFORMS** Laplace transforms, inverse Laplace transforms, Properties of Laplace transforms, Laplace transforms of unit step function, impulse function, Convolution theorem; Applications of Laplace transforms - solving certain initial value problems.	**CO1**	**10**
02	**FOURIER SERIES** Expansion of a function in Fourier series for a given range - Half range sine and cosine expansions.	**CO1/ CO2**	**07**
03	**FOURIER TRANSFORMS** Fourier Integrals, Fourier transforms-sine, cosine transforms and inverse transforms - simple illustrations	**CO5**	**10**
04	**VECTOR CALCULUS** Line integrals, surface integrals, Integral Theorems: Greens theorem, the divergence theorem of Gauss and Stoke's theorem	**CO4**	**10**
05	**PARTIAL DIFFERENTIAL EQUATIONS** Method of Separation of variables for solving partial differential equations, first and second order one dimensional wave equation, heat equation and two-dimensional Laplace equation.	**CO4**	**08**

		/CO5	

Note: *1-Low, 2-Medium or 3- High.*

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, 2015.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Fifth Edition, Narosa Publishing House, 2016.
3. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, Inc. Mineola New York.

SEMESTER II

MATHEMATICS-IV: Statistical and Numerical Methods

(L-03, T-00, P-00, CREDITS TH.-03, P-00)

Course Code: BSC274

Course Objectives:

Objective 1. To provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.

Objective 2. To understand probability distributions and their properties

Objective 3. To learn the statistical parameters for different distributions, correlation and regression

Objective 4. To understand the method of curve fitting, testing of hypothesis, goodness of fit

Objective 5. To understand the interpolation and approximation, Numerical differentiation and numerical integration.

Objective 6. To learn various numerical techniques to solve ordinary and partial differential equations.

Course Outcomes:

After successful completion of this course student will be able to:

BSC 274.1. To develop techniques of data interpretation.

BSC 274.2. Develop problem solving techniques needed to accurately calculate probabilities and describe the properties of discrete and continuous distribution functions.

BSC 274.3. Use statistical tests in testing hypotheses on data, compute covariances, and correlations, Apply the tests of goodness of fit.

BSC 274.4. Develop the numerical skills for finding roots of polynomial and transcendental equations.

BSC 274.5. Conduct numerical integration and differentiation and solve ODE's and PDE's and engineering problems.

Articulation Matrix

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

Note: *1-Low, 2-Medium or 3- High.*

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**ANALYSIS OF STATISTICAL DATA** Frequency distribution; Frequency curve and histogram; Measure of central tendency and dispersion.	**CO1**	**03**
02	**RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS** Basic concepts of probability and its properties; Conditional probability and independent events; Random variables, discrete and continuous random variables, Mean and variance of Binomial, Poisson and Normal distributions and applications.	**CO1/ CO2**	**08**
03	**SAMPLING DISTRIBUTIONS AND INTERVAL OF ESTIMATION** Sampling Distributions: t distribution, Chi-square distribution, F-distribution; Interval of estimation	**CO5**	**08**

04	**V-TESTING OF HYPOTHESIS** Relation between confidence interval and testing of hypothesis; testing of hypothesis, classification of hypothesis tests; large sample tests, small sampe tests.	**CO3/** **CO4**	**10**
05	**NUMERICAL METHODS – 1** Solution of polynomial and transcendental equations – Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**CO5/** **CO6**	**08**
06	**NUMERICAL METHODS – 2** Numerical solutions to differential equations: Taylor series method, Euler method, Runge-Kutta method, predictor-corrector methods for initial value problems, Adams-Moulton method, Numerical solutions to partial differential equations: Finite difference method, Explicit, implicit, Crank-Nicolson method.	**CO7**	**10**

Reference Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, John Wiley and Sons, 2015.
2. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, 7th Edition, McGraw Hill.
3. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI learning Pvt. Ltd.
4. V. K. Rohatgi and A.K. Md. Ehsanes Saleh, An Introduction to Probability and Statistics, 2nd Edition.
5. D. C. Montgomery and G.C. Runger, "Applied Statistics and Probability for Engineers", 5th edition, John Wiley & Sons, (2009).
6. P. S. Mann, Introductory Statistics, Wiley Publications, 7th edition (2013).

THEORY OF MACHINES

(L-04, T-00, P-02, CREDITS TH.-04, P-01)

Course Code: PCC-PE206

Course Objectives:

Objective 1. To understand commonly used mechanisms for industrial applications.

Objective 2. To develop competency in drawing velocity and acceleration diagrams for simple and complex mechanisms.

Objective 3. To understand the concepts of motion transmission elements.

Course Outcomes:

On successful completion of this course, students should be able to:

PCC-PE206.1. Understand the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.

PCC-PE206.2. Analyze the planar mechanisms for position, velocity and acceleration.

PCC-PE206.3. Synthesize planar four bar and slider crank mechanisms for specified kinematic conditions.

PCC-PE206.4. Design flywheel for specific application.

PCC-PE206.5. Understand the working of governor.

PCC-PE206.6. Evaluate gear tooth geometry and select appropriate gear geometry for the required applications.

PCC-PE206.7. Design cams and followers for specified motion profiles.

Articulation Matrix

	Name of Course	**PO**			**PSO**		
		1	**2**	**3**	**1**	**2**	**3**
PCC-PE206	Theory of Machines	1	2	2	2	2	1
PCC-PE206.1	Describe the principles of kinematic pairs, chains and their classification, DOF, inversions, equivalent chains and planar mechanisms.	2				2	
PCC-PE206.2	Analyze the planar mechanisms for position, velocity and acceleration.		3		2		1
PCC-PE206.3	Synthesize planar four bar and slider crank mechanisms for specified kinematic conditions.		2	2	1	1	
PCC-PE206.4	Evaluate gear tooth geometry and select appropriate gears for the required applications.			2	1		
PCC-PE206.5	Design cams and followers for specified motion profiles.			2			1

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks

Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**MECHANISMS AND INVERSIONS**: Mechanisms, machines, kinematics pairs, kinematics chains, kinematics inversions. **Velocity and acceleration analysis:** Instantaneous center, Kennedy's three center theorem, Instantaneous center method and relative velocity method for velocity diagrams, acceleration diagram. Short cut methods for velocity and acceleration diagrams.	**CO1/ CO2 /CO3**	**12**
02	**BALANCING OF MASSES:** Need for balancing, Balancing of one / several masses rotating in one/different planes, the effect of inertia force of a reciprocating mass on the engine frame, partial primary balance.	**CO3**	**06**
03	**TURNING MOMENT AND FLYWHEELS:** Turning moment diagram for an IC engine, fluctuation of energy and speed, design of flywheel. **Governors:** Introduction, types of governors, centrifugal governors, watt governor, porter governor, proell governor, spring loaded governors, Hartnell governor, sensitiveness, stability, Isochronisms, Hunting, governor effort and power, controlling force.	**CO4 /CO5**	**08**
04	**CAMS:** Introduction, definition, Applications, types of cams, types of followers, cam terminology, high speed cams. Motions of follower, Displacement, velocity and acceleration time curves for different follower motions, layout of cam profile, cams with specified contours.	**CO7**	**08**

05	**GEARS:** Concept of friction wheel, types of gears, gear terminology, law of gearing, velocity of sliding, forms of teeth, gear profiles, path of contact, arc of contact, Interference and undercutting in involute gears, methods of eliminating reducing/ Interference.	**CO6**	**08**

Term Work:

It shall consist of a journal prepared by conducting following practical.

1. Study of at least four inversions of each single slider and double slider crank mechanisms.
2. Drawing of kinematic link diagram for a given mechanisms.
3. At least 4 typical problems of velocity and acceleration analysis to be solved on quarter imperial size drawing sheet.
4. Practical on vibration analysis of spring mass system, simple and compound pendulum.
5. Practical demonstration on Gyroscope.
6. Study of static and dynamic balancing.
7. Study of generation of involutes tooth profile.
8. Four sheets on cam profile generation.
9. Practical analysis on four types of Governors

Practical Examination (4hrs):

It shall consist of an oral based on the term work prescribed above and practical performed.

Text Books:

1. Thomas Bewan, “Theory of Machines” Pearson Education India, 1994
2. David H. Myszka, “Machine and Mechanisms: Applied Kinematic Analysis”, Prentice Hall, 2010
3. Rattan, “Theory of Machines” Tata McGraw-Hill Education 2005.
4. R.S. Khurmi, G. K. Gupta, “Theory of Machines”, Eurasia Publishing House, 2005

Reference Books:

1. Shigley, Joseph Edward, “Theory of Machine & Mechanisms”, McGraw Hill Inc. 1981 P.L. Ballaney, “Theory of Machines” Khanna Publishers 1987.

THERMAL ENGINEERING - II

(L-03, T-00, P-02, CREDITS TH.-03, P-01)

Course Code: PCC-PE207

Course Objectives:

Objective 1. To study air compressors and its applications

Objective 2. To get conversant with vapour power cycles and steam turbines.

Objective 3. To understand the fundamentals and performance of refrigeration and air conditioning systems.

Course Outcomes:

On successful completion of this course, students should be able to;

PCC-PE207.1. Describe fundamentals of air compressors and their applications.

PCC-PE207.2. Design and evaluate refrigeration and air conditioning system.

PCC-PE207.3. Analyze the properties of fuel and flue gases.

PCC-PE207.4. Demonstrate the working of power plant.

PCC-PE207.5. Select the psychometric properties of air for human comfort.

Articulation Matrix

	Name of Course	**PO**				**PSO**		
		1	**2**	**3**	**4**	**1**	**2**	**3**
PCC-PE207	Thermal Engineering- II	1	3	1	2	2	1	2
PCC-PE207.1	Describe fundamentals of air compressor, their applications and evaluate their performance.	3					2	
PCC-PE207.2	Design and evaluate refrigeration and air conditioning system under different conditions and select the TR required.	3	3		3	3		3
PCC-PE207.3	Compare the merits and demerits of fuels, analyze the flue gases and find the air required for complete combustion of fuel.	3	3		2			1
PCC-PE207.4	Demonstrate the working of power plant.					2		3
PCC-PE207.5	Select the psychometric properties of air for human comfort.				1			

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**AIR COMPRESSOR:** Uses of compressed air, classification, reciprocating compressor terminology, working, work done, methods of achieving isothermal compression, minimizing compression work, advantages of multi-stage air compressor, multistage air compressor with intercooler, cylinder dimensions of a multistage compressor, power and efficiencies, effect of clearance volume on volumetric efficiency, actual indicator diagram, free air delivery (FAD), rotary compressors, roots blower compressor, vane-type compressor, centrifugal compressor, axial compressor.	**CO1**	**06**
02	**FUELS AND COMBUSTION:** Types of Fuels, calorific values, combustion of fuel, amount of theoretical and actual air required for complete combustion of fuel, conversion of volumetric analysis to gravimetric analysis and vice a versa, air–fuel ratio, air–fuel ratio from analysis of flue gases, flue gas analysis.	**CO3**	**06**
03	**REFRIGERATION:** Refrigeration, Refrigerators and Heat Pumps, Refrigeration terminology, types of refrigeration systems, gas refrigeration Systems, Brayton refrigeration cycle, Bell Coleman cycle, ideal vapour compression refrigeration cycle, vapour absorption refrigeration cycle, comparison of vapour absorption system with vapour compression system, steam jet refrigeration, heat pump, refrigerants.	**CO2**	**08**
04	**PSYCHROMETRY:** Psychrometer, dry, moist and saturated air, properties of moist air, partial pressure of air and vapour, adiabatic saturation temperature, psychrometric chart, air-conditioning processes, adiabatic mixing of two moist air	**CO5**	**08**

	streams, air washer		
05	**AIR CONDITIONING:** Applications of air-conditioning, comfort air-conditioning, effective temperature, air-conditioning cycle, summer air-conditioning system, winter air- conditioning system, year-round air conditioning system, unitary system, central air- conditioning system, classifications of central air-conditioning system, rating of air- conditioning, cooling and heating load calculations, sensible heat factor, ice plant, air coolers, difference between air cooler and air-conditioner.	**CO2**	**06**
06	**VAPOUR POWER CYCLES:** Steam power plant, performance parameters of vapour power cycle, Carnot vapour power cycle, Rankine cycle, comparison between Carnot and Rankine cycle, irreversibilities and losses in vapour power cycle, effect of operating variables on Rankine cycle, reheating of steam, super critical Rankine cycle, mean temperature of heat addition, modified Rankine cycle.	**CO3**	**06**
07	**INTRODUCTION TO STEAM TURBINES:** Classification of steam turbines, working of impulse steam turbines, reaction steam turbines, velocity diagrams.	**CO4**	**04**

Term Work:

Part-I: Laboratory work

Conduct of following laboratory experiments

1. Trial on Refrigeration test rig
2. Trial on Air conditioning test rig.
3. Trial on Ice Plant tutor.
4. Trial on reciprocating air compressor.
5. Trail on rotary air compressor.
6. Determination of properties such as calorific value of solid/liquid/gas fuel, etc.
7. Analysis of flue gas (any one flue gas analyzer)

Part-II: Assignments:

Record of at least six assignments preferably based on latest development in a particular field based on above syllabus.

Practical Examination:

Practical examination consists of viva-voce/oral by external/internal examiner.

Reference Books:

1. M. M. Rathore, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. B. K. Sarkar, 'Thermal Engineering', Tata McGraw Hill Publishing Company Ltd. New Delhi.
3. R. K. Rajput, 'Thermal Engineering', Laxmi Publications Pvt. Ltd, New Delhi
4. J.Selwin Rajadurai,'Thermodynamics and Thermal Engineering', New Age International Publishers, New Delhi.
5. P. L Ballany, 'Thermal Engineering', Khanna Publishers, New Delhi.

MECHANICAL MEASUREMENT AND METROLOGY

(L-03, T-00, P-02, CREDITS TH.-03, P-01)

Course Code: PCC-PE208

Course Objectives:

Objective 1. To study need of metrology and basic terminology of metrology

Objective 2. To learn the basics of limit, fit, tolerances and gauge designing

Objective 3. To study the principles of measurement of various mechanical properties such as geometrical, dimensional, surface finish, pressure, temperature etc.

Objective 4. To learn the use of various measuring instruments with different setups for accurate measurements.

Objective 5. To get acquainted with various standards of measurements & the calibration process of instruments

Course Outcomes:

On successful completion of the course, students should be able to:

PCC-PE208.1. Use linear and angular measuring instruments.
PCC-PE208.2. Design tolerances and fits for selected product quality
PCC-PE208.3. Identify suitable comparator and light waves for different measurements.
PCC-PE208.4. Understanding of basic concepts of mechanical measurement and errors in measurements.
PCC-PE208.5. Measure various machining process by measuring surface finish of the component produced workout for surface integrity parameters.
PCC-PE208.6. Select appropriate temperature and pressure measuring device for various applications.

Articulation Matrix

	Name of Course	PO					PSO		
		1	2	3	4	5	1	2	3
PCC-PE208	Mech. Measurements & Metrology	2				3	2	2	2
PCC-PE208.1	Demonstrate measuring instruments for linear and angular measurement.	3					1	1	1
PCC-PE208.2	Define and describe types of errors, limits and fits.	2					1	1	1
PCC-PE208.3	Design gauges for internal and external measurements.					3	1	1	1
PCC-PE208.4	Identify suitable comparator for different measurements					1	1	1	1
PCC-PE208.5	Demonstrate use of instruments for pressure and temperature measurement.					3	1	1	1

Evaluation Scheme:

Theory	Mid Term Examination	30
	End Term Examination	50
	Continuous Evaluation	20
Term work/ Practical	Continuous Evaluation	50
	Internal Viva-voce	50

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**INTRODUCTION:** Need, Precision, Accuracy, Errors, Linearity, Repeatability, Methods of Measurement. Linear Measurement: Vernier Callipers, Height Gauge, Depth Gauges, Feeler Gauges, Micrometer, Slip Gauges. Measurement Standards: Line Standard, End Standard, Wavelength Standard, Classification of Standards,GD&T.	**CO1**	**06**
02	**LIMITS, FITS AND GAUGES:** Tolerances, Interchangeability, Selective Assembly Terminology, Limits Of Size, Allowances, Clearances, Interference, Fits, Selection Of Fits, Numerical Problems On Limits of Size And Tolerances, Gauges (Ring, Snap), Taylor's Principle, Gauge Design, Tolerance and Geometry, Geometric Dimensioning and	**CO2**	**06**

	Tolerance.		
03	**COMPARATORS:** Definition, Types, Characteristics, Applications, Construction and Working of Different Mechanical, Electrical, Optical, and Pneumatic Comparators.	**CO3**	**04**
04	**MEASUREMENTS BY LIGHT WAVE INTERFERENCE:** Basic Principle, Optical Flats, Fringe Patterns and their Interpretation, Testing Of Flat Concave, Convex and Irregular Surfaces, and Checking of Slip Gauges, Michelson Interferometer, NPL Flatness Interferometer.	**CO3**	**06**
05	**MECHANICAL MEASUREMENT:** Principle and Applications of Measuring Instruments Like Protractor (Optical and Bevel), Sine Bar, Angle Gauges, Spirit Level, Clinometers, Autocollimator, Angle Dekker, Constant Deviation Prism, and Miscellaneous Measurement of Angle, Profile Projector, Toolmaker's Microscope and CMM.	**CO4**	**06**
06	**MEASUREMENT OF SURFACE FINISH AND SURFACE CHARACTERISTICS:** Definitions, Terminology and Basic Concepts, Methods of Measuring Surface Finish, Analysis of Surface Roughness, Symbols and Values of Surface Roughness, Straightness, flatness, squareness, parallelism etc.	**CO5**	**05**
07	**PRESSURE MEASUREMENT:** Definition of pressure, Units, Types of pressure measurement devices, Manometers, Dead weight tester, types of gauges, Bourdon tube pressure gauge, Diaphragms and bellows, Low pressure measurement, Piezo electric transducer Selection of pressure measuring devices for specific applications, Calibration of pressure measuring devices.	**CO6**	**06**
08	**TEMPERATURE MEASUREMENT:** Temperature scales, Ideal gas, Temperature measuring devices, Thermometer, Bi- metallic strip, Electrical resistance thermometer, Thermostats and thermocouples, Laws of thermocouples and their applications, Construction and calibration of thermocouples, Radiation pyrometers, total radiation pyrometers.	**CO6**	**06**

Term Work:

The term work shall consist of record of following experiments and one to two assignments on every chapter.

1. Use of precision measuring instruments for linear measurements.
2. Experiment on mechanical comparator and study of different types comparators.
3. Experiment on sine bar for measurement of taper angle.

4. Study of auto collimator / angle dekkor.
5. Experiment on pitch errors of screw threads.
6. Assignment on design of gauges.
7. Experiment on profile projector/ Tool maker's Microscope.
8. Experiment on Coordinate Measuring Machine.
9. Experiment on Height master
10. Experiment on pressure and temperature measurements.

Text Books:

1. R.K. Jain, "Engineering Metrology", Khanna Publication, New Delhi 1997
2. K.J.Hume, "Engineering Metrology", Kalyani publication ISBN8170290015
3. I. C. Gupta, "A Text book of Engineering Metrology", Dhanpat Rai and Sons

Reference Books:

1. Engineering Metrology and Measurements, N.V.Raghavendra and L.Krishnamurthy, Oxford University Press.
2. Engineering Metrology and Measurements, Bentley, Pearson Education.
3. Theory and Design for Mechanical Measurements, III edition, Richard S Figliola, Donald E Beasley, WILEY India Publishers.
4. Engineering Metrology, Gupta I.C., Dhanpat Rai Publications.
5. Beckwith, T. G. and W.L. Buck: "Mechanical Measurements", 2nd Edition, Addison Wisely Publishing Company, Reading, Mass, 2000 ISBN8131702073
6. D. S. Kumar, "Mechanical Measurement & Control", Metropolitan Book Co. (P) Ltd., ISBN 81 200 0214-8
7. Deoblin's Measurement system, Ernest Deoblin, Dhanesh manick, McGraw –Hill.

MACHINING PROCESSES

(L-03, T-00, P-00, CREDITS TH.-03, P-00)

Course Code: PCC-PE209

Course Objectives:

Objective 1. The main objective of this subject is to make student aware of tool geometry, tool signature, and mechanics of chip formation, types chip, tool wear, surface finish and need of cutting fluids, machininabilty of the material helps in selection of tool material.

Objective 2. Study of various features and capabilities of various machine tool types, parts, accessories attachments, and operations performed and time required, assists in selection of proper machine tool for a particular application.

Objective 3. Study of advances in machine tools and finishing processes helps to take decision for selection of proper machine tool for batch and large size machining applications.

Course Outcomes:

On successful completion of this module, students should be able to:

PCC-PE209.1. Enlist the different factors affecting on tool life, surface finish and the different types of chips.

PCC-PE209.2. Compute machining times for machining operation on machine tools.

PCC-PE209.3. Describe basic principle operation of lathe, shaper, drilling, milling, and planning, slotting, boring and broaching machines.

PCC-PE209.4. Describe basic principle of Numerical control machine.

PCC-PE209.5. Identify different processes for finishing of work pieces.

Articulation Matrix

	Name of Course	**PO**			**PSO**		
		1	**2**	**3**	**1**	**2**	**3**
PCC-PE209	Machining Processes	2		1	1	3	3
PCC-PE209.1	Identify different factors affecting on tool life, surface finish, formation of different types of chips and use of lubricants.	2					3
PCC-PE209.2	Compute machining times for machining operation on machine tools.			2		2	
PCC-PE209.3	Describe construction and basic operation performed on lathe, shaper, drilling, milling, and planning, slotting, boring and broaching machines.	3					
PCC-PE209.4	Compare different processes used for finishing of work pieces.	2					

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks
Term work/Practical	Continuous Evaluation	50 Marks
	External Viva-voce	50 Marks

Course contents:

Unit	Chapter	CO Covered	Hrs
01	**INTRODUCTION:** Definition, Principles, Types, Components, Machining Parameters, Drives and Power Requirements.	CO1	06
02	**THEORY OF METAL CUTTING:** Tool Geometry, Tool Signature, Chip Formation, Types of Chip, Tool Wear, Surface Finish, Cutting Fluids and Machinability, Selection of Tool Materials.	CO1	06
03	**MACHINE TOOLS:** Machining Principles, Setting For Typical Products and Operations, Types, Parts, Accessories and Attachments Of Lathe, Drilling, Milling, Shaping, Planning, Slotting, Boring And Broaching Machines. Machining Time Calculations for Lathe, Drilling, Shaping, Planning And Milling Machines	CO3	10
04	**GRINDING MACHINES:** Principle, Constructional Details, Components, Types of Grinding Processes, Accessories. Grinding Wheels - Specifications, Shapes, Applications, Dressing and Truing, Mounting, Cutting Fluids Used In Grinding. Selection of Grinding Wheels.	CO3	10
05	**FINISHING PROCESSES:** Lapping, Honing, Super Finishing Operations, Polishing, Buffing, Metal spraying, Galvanizing, Electroplating etc. Tools used For These Operations.	CO5	07
06	**COMPUTER NUMERICAL CONTROL** Classification of Numerical control machine, Constructional details of CNC machines, fundamental of part programming , do loops , canned cycles use of subroutines, tooling for CNC machines, maintenance of CNC machine tools	CO4	06

Reference Book:

1. Hajra Chaudhary, S.K. and Hajra Chaudhary A.K., Elements of Workshop Technology, Vol-II, Media Promoters Pub Ltd, Mumbai,1986

2. Rao, P.N., Manufacturing Technology-Metal Cutting and Machine Tools, Tata McGraw Hill, New Delhi,2000
3. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai Publication, 9th Edition, 1999
4. Serope Kalpakjian, Manufacturing, Engineering Technology, Published by Pearson 4th Edition, 2005.
5. Material & Processes in Manufacturing, E Paul De Garmo, J T Black, PHI.
6. Fundamental of Machining & Machine Tools, Juneja&Sekhon, New Age International 2008.

MANUFACTURING LAB - I

(L-00, T-00, P-02, CREDITS TH.-00. P-01)

Course Code: LAB-PE210

Course Objectives:

Objective 1. To gain an understanding and appreciation of the breadth and depth of the field of manufacturing.

Objective 2. To recognize the strong interrelationships between material properties and manufacturing processes.

Objective 3. To become familiar with some of the basic metal cutting processes.

Objective 4. To learn and apply the basic terminology associated with these fields.

Objective 5. To increase your knowledge and broaden your perspective of the manufacturing world in which many of you will contribute your talents and leadership.

Course Outcomes:

LAB-PE210.1. On successful completion of this module, students should be able to:

LAB-PE210.2. Describe the basics working principle of Lathe, Milling, Drilling, Grinding, Shaper, Planning, Slotting, Boring, Broaching and Finishing processes.

LAB-PE210.3. Compute the machining time for Lathe, Drilling, Grinding, Milling, Shaper, Planning, Slotting, Boring, Broaching processes, through experiments.

LAB-PE210.4. Acquire machining skill by working on lathe, milling machine.

LAB-PE210.5. Write simple NC/ CNC part program for lathe operation.

Evaluation Scheme:

Term work/ Practical	Mid Term Continuous Evaluation	50Marks
	End Term Continuous Evaluation	50 Marks

Term work:

It shall consist of following study of working, constructional details, various mechanisms, accessories, attachments and different operations of Lathe and CNC lathe, Milling M/c, Drilling M/c, and Grinding M/c, shaper, planer, slotting M/c, Boring M/c, Broaching M/c and Finishing processes.

Each student will prepare and submit the following jobs.

1. External taper turning - 01 Job
2. Internal taper turning- 01 job
3. Eccentric turning - 01 Job
4. A simple job on CNC Lathe
5. Estimate machining times for machining operation on machine tool. ***Note:*** *The student shall submit the record of term work in the form of journal.*

HUMAN VALUES AND PROFESSIONAL ETHICS

(L-02, T-00, P-00, CREDITS TH-02, P-00)

Course Code: HMC278

Course Objectives:

Objective 1. To create an awareness on Professional Ethics and Human Values

Objective 2. To help students understand the Harmony for life.

Objective 3. To understand co-existence

Objective 4. To study the moral issues and decisions confronting individuals and organizations in profession.

Course Outcomes:

After completion of the course the student is able to:

HMC278.1. Understand the core human values that shape the ethical behavior of a person.

HMC278.2. Understand how values act as an anchor of actions for life.

HMC278.3. Learn the need of Human values and Professional ethics in life.

HMC278.4. Understand Harmony at Four levels of life.

HMC278.5. Learn the moral issues and problems in profession and find the solution to those problems.

HMC278.6. Understand the core human values that shape the ethical behavior of a person.

Articulation Matrix:

PO → / CO ↓	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1			1			2		3				
CO-2								3				
CO-3								3				3
CO-4						2		3				
CO-5			1			2		3	2			3

Evaluation Scheme:

Theory	Teacher Evaluation Component	20 Marks
	Mid Term Examination	30 Marks
	End Term Examination	50 Marks

Course Contents

Unit	Chapter
01	**INTRODUCTION:** Need, basic guidelines, content and process for value education, Moral values, Social, Environmental, Economic values, Purusharth, Duty, Justice, Equality. t at basic aspirations: self exploration, happiness and prosperity, Fulfillment of human tions.
02	**UNDERSTANDING THE HARMONY** Thoughtful human being harmony, sentient, attitude and its importance in relationship, significance of restraint and health *(Yama and Niyama)*, Egoism, Altruism, Universalism (idea of Sarvodaya and Vasudevkutumbakam), The problem of hierarchy of values and their choice (View of Pt Madan Mohan Malviya and Mahatma Gandhi), human goal settings and life management techniques.
03	**UNDERSTANDING PROFESSIONAL ETHICS** Harmony at various levels and understanding professional ethics, creating environmentally aware engineers, humanistic universal education, humanistic universal education, natural acceptance of human values, ethical human conduct.
04	**COMPETENCE OF PROFESSIONAL ETHICS** Management models for present technologies, strategies for integrating humans in family and at all levels of existence, relevance of the above strategies in becoming responsible engineers, technologists and managers.
05	**MOTIVATION** Contribution of ancestors in science and technology development to raise self esteem in Indian context.

Text Books/ Reference Books:

1. R. R. Gaur, R. Sangal, G. P. Bagaria, A Foundation Course in Value Education, 2009.
2. A. Nagraj, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak, 1998.
3. Sussan George, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. P. L. Dhar, R. R. Gaur, Science and Humanism, Commonwealth Purblishers, 1990.
5. A. N. Tripathy, Human Values, New Age International Publishers, 2003
6. Subhas Palekar, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati, 2000.
7. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, Limits to Growth – Club of Rome's report, Universe Books, 1972.
8. E. G. Seebauer & Robert L. Berry, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press, 2000.
9. M. Govindrajran, S. Natrajan & V. S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
10. Subroto Bagchi, The Professional.
11. B. P. Banerjee, Foundations of Ethics and Management, Excel Books, 2005.
12. B L Bajpai, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, 2004, Reprinted 2008.
13. Dr. Nityanand Mishra Niti Shastra ,Motilal Banarasidas 2005.
14. Dr. Avdesh Pradhan Mahatma ke Vichar , BHU Varanasi 2007