



- A) **Course Code** : 2037C01BT037
 B) **Course Title** : Strength of Materials
 C) **Pre-requisite Course Code and Title** : None
 D) **Rationale** :

The external effects due to action of force system have already been studied in Applied Mechanics in previous Semester. All Mechanical Engineering Components and members are subjected to different loading conditions resulting into different types of stresses accordingly. In this course, estimation of induced stresses, strains and strain energy of determinate structures/components under action of these transverse, axial, thermal and shear loading along with bending and torsion moment are performed. Moreover, this course will lay sound foundation for analysis and design of Machine Components going to be discussed in latter semesters.

E) Course Outcomes:

- CO-1** Estimate direct stresses and strains in machine members/components.
CO-2 Determine bending moment and shear force values in different types of beams/components subjected to transverse loading.
CO-3 Calculate bending stresses using bending moment values in different types of beams/components subjected to transverse loading.
CO-4 Calculate slope and deflection in cantilever and simply supported beams/components subjected to transverse loading.
CO-5 Estimate shear stresses in shafts subjected to twisting moment.
CO-6 Determine buckling load in Columns and Struts type high slenderness ratio components.

F) Scheme of Studies and Assessment:

S.N O	Board of Studies (BOS)	Course (Subject)	Subject Code	Period per Week			Scheme of Examination			Total Mark s	Cre dits	Teachin g Hour	Assessm ent Hour
				L	T	P	Theory/Lab						
							ESE	CT	TA				
1.	Mechanica I	Strength of Materials	2037C01BT037	2	1	-	100	20	20	140	3	45	15

Legend: L: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), P: Laboratory Instruction (Includes Practical performances in laboratory/ workshop, field or other locations using different instructional strategies), ESE: End Semester Examination, CT: Class Test, TA: Teachers Assessment (Sessional Work includes assignment, seminar, mini project etc.)

Note: SW and SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

- CO-1** Estimate direct stresses and strains in machine members/components.



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Identify various types of loadings in the given machine component with justification. SO1.2 Select suitable elastic moduli in the given problem with justification. SO1.3 Evaluate behavior of the given material subjected to static longitudinal, lateral Loads and thermal variation. SO1.4 Estimate direct stresses and strains in the given Composite and Compound Sections. SO1.5 Compute Strain Energy under the given types of loading on the given member.		Unit-1.0 Direct Stresses and Strains in components 1.1 Direct Stress, linear Strain, Hook's Law, Calculation of Direct Stress and Linear Strain, factor of Safety. Lateral Strain and Poisson's ratio, numerical problems. 1.2 Temperature Stresses and Strain with and without yielding, numerical problems. 1.3 Shear Stress, Shear Strain and Shear Modulus, numerical problems. 1.4 Bulk Modulus and Volumetric Strain, Relation between E, G and K (No derivation). 1.5 Differentiate Sudden, Gradual and Impact Load, Strain Energy and Proof Resilience for Sudden, Gradual and Impact Load with numerical problems.	• Comparison between static and dynamic loads on machine elements.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Identify different loads and their effects in various domestic and industrial components. Prepare a list of the same.
- Solve numerical problems related to direct stresses and strains.
- Identify at least five impact and sudden loadings situations in day to day life and prepare a list.
- Collect specification of Universal Testing Machine (UTM) in your lab and explain the function of each part.
- List out different types of test that can be performed on a UTM.

b. Mini Project:

- Prepare a model showing the effects of thermal stresses on beams.

c. Other Activities (Specify):

- Visit a nearby industry/workshop to identify the various failures in machine components due to direct stresses.

CO-2 Determine bending moment and shear force values in different types of beams/components subjected to transverse loading.

(Approx. Hrs. : CI+LI+SW+SL= 10)



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Draw Shear Force and Bending Moment Diagram for the given Statically Determinate Beam. SO2.2 Identify location of point of contra flexure in the given situation with justification.		Unit-2.0 Shear Force and Bending Moments in Beam type components 2.1 Statically Determinate Beams like Cantilever, Simply Supported and Over Hang Beam. 2.2 Relation between Shear Force and Bending Moment. 2.3 Sagging and Hogging Bending Moment and its importance. 2.4 Point of Contra flexure and its importance. 2.5 S.F and B.M Diagram for Cantilever, Simply Supported and Over Hanging Beam. Simple numerical problems with point load and UDL.	• SF and BM variations in few standard machine components.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Prepare a list of machine components subjected to lateral loads and identify end conditions and type of loading.
- Solve numerical problems related to S.F and B.M Diagram for Cantilever, Simply Supported and Over Hang Beams type components.

b. Micro Project:

- Prepare a model of wood and acrylic showing various beams and their supports.

c. Other Activities (Specify):

- Prepare a chart to show SF and BM diagrams and its max values for various loading conditions in simply supported beams.
- Prepare a chart to show SF and BM diagrams for various loading conditions in cantilever beam.

CO-3 Calculate bending stresses using bending moment values in different types of beams/components subjected to transverse loading.

(Approx. Hrs. : CI+LI+SW+SL= 15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Identify machine components subjected to lateral and axial eccentric loads with justification. SO3.2 Calculate bending stress in the given situation.		Unit-3.0 Bending stresses in beam type components 3.1 Bending Theory Equation Bending stress, Sectional Modulus 3.2 Neutral Axis, application of Bending theory to Statically determinate beams	• Analyze Structural components subjected to Axial Eccentric Loads.



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.3 Calculate resultant stress and draw resultant stress variation diagram for the given axial eccentric situation.		elements like shaft, axle, spindle, pulley arm having rectangular or circular section to find out stresses. 3.3 Structural components subjected to Axial Eccentric Loads. Simple numerical problems.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Locate the neutral axis for beams of different cross sections under bending loads.
- Solve numerical problems related to bending stresses in machine component loaded with transverse loads.

b. Micro Project:

- Identify different parts subjected to bending stresses in a lathe/shaper/planer machines in a mechanical workshop and compare them with the standard beams and the loadings. Prepare a report on the same.

CO-4 Calculate slope and deflection in cantilever and simply supported beams subjected to transverse loading.

(Approx. Hrs. : CI+LI+SW+SL=17)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Determine deflection and slope in a given statically determinate Beam mentioned in 4.2 and 4.3.		Unit-4.0 Deflection of beam type components 4.1 Concept of Slope and Deflection. Macaulay's method 4.2 Deflection Formula for Cantilever Beam subjected to Point Load at free end and with full UDL. 4.3 Formula for Simply supported Beam subjected to Point Load at Mid Span and with full UDL. Simple numerical problems.	Deflection of beams subjected to Point load at any point in beam

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Prepare a chart for maximum deflections in Simply Supported and Cantilever beams.
- Solve problems related to deflection of components under transverse loading.



b. Micro Project:

- i. Prepare a working model to measure deflection in digital form using sensors/potentiometer/transducers of a cantilever beam with facility to vary the position of a point load.

c. Other Activities (Specify):

- i. Prepare a list of machine components where deflection is desirable and non-desirable for the functioning.
- ii. Perform internet search to prepare a list of software used to draw and estimate shear force, bending moment and deflection of beams.

CO-5 Estimate shear stresses in shafts subjected to twisting moment.

(Approx. Hrs. :CI+LI+SW+SL=14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Calculate the power transmitted by the given solid and hollow shafts. SO5.2 Calculate angle of twist and shear strain in given solid shaft.		Unit-5.0 Torsion of Shaft 5.1 Torsion, Angle of Twist, Polar Moment of Inertia, Torsional Rigidity. 5.2 Formula of Torsional Stress. 5.3 Formula for Power Transmitted /Consumed for shaft, spindle and axle of solid and hollow sections subjected to Torsion.Simple numerical problems.	Compound Shafts

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- i. Compare torsional rigidity for shafts of same length, diameters but different material.

b. Micro Project:

- Survey the nearby domestic industries (minimum 05 industries) and list the various power transmission devices with their technical specification and use and give justification for selecting the drive, also state the problems aroused during the use and their remedial measures taken. .

c. Other Activities (Specify):

- i. Collect data of three shafts of three different electric motors available in your college like length, diameter and material. Note down the power and speed of the motor and comment on the shaft diameters used.

CO-6 Determine buckling load in Columns and Struts type high slenderness ratio components.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning
SO6.1 Identify the machine components that can be treated as columns/ struts with justification. SO7.2 Determine Rankin's load / Buckling Load of Column for the given loading situation. SO7.3 Determine Euler's load / Buckling Load of Column for the given loading situation.		Unit-6.0 Buckling stresses in Columns and Struts type components 6.1 Column and Strut 6.2 Short and Long Column. 6.3 End Condition of Column 6.4 Effective Length of Column. 6.5 Radius of Gyration, Slenderness Ratio. 6.6 Rankin's load / Buckling Load and its Application. 6.7 Euler's load / Buckling Load and its application Simple Numerical problems.	Buckling of beams Buckling of beams

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Prepare a list of machine components that can be considered as column and struts and also mention about their end conditions.
- Draw graph between slenderness ratio and induced stress of a mild steel column and identify the limit up to which the Euler's/Rankin's formula is valid.

b. Micro Project:

- Prepare a model of acrylic column and make provision for all four types of end conditions. Try to predict the equivalent length from it.

D) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Direct Stress and Strain in components	2	2	16	20
II	Shear Force and Bending Moments in Beam type components	2	2	12	16
III	Bending Stresses In Beam type components	2	2	12	16
IV	Deflection of beam type components	2	2	12	16
V	Torsion of Shafts	2	2	12	16
VI	Column and Struts	2	2	12	16
Total		12	12	76	100

Legend: R: Remember, U: Understand, A: Apply and above

K) Suggested Instructional/Implementation Strategies:

- Improved Lecture
- Tutorial
- Case Method
- Group Discussion
- Industrial visits
- Industrial Training
- Field Trips
- Portfolio Based Learning



9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:**(a) Books :**

S. No.	Titles	Author	Publisher and Edition*	ISBN
1	Strength of Material and Mechanics of Structures	Dr. B C Punamia	Laxmi Publications (p) Ltd. New Delhi, 10/e, 2015,	9788131809259
2	Strength of Material	S Ramamurutham	Dhanpat Rai Publishing Company Private Limited-New Delhi; Eighth edition, 2014	9789384378264
3	Strength of Material	Timoshenko and Gere	CBS, 2 edition, 2006,	9788123908946
4	Theory of Structures	R S Khurmi	S. Chand Publishing, New Delhi, 2006	9788121928229
5	Strength of Materials	R.K. Rajput	S. Chand Publishing (6th Edition) (2015)	9789385401367
6	Strength of Materials	Rattan S.S.	McGraw Hill Education; Third edition, 2016,	9789385965517
7	Material Capability	S. S. L. Patel	Standard Publishers	9788180142406
8	Material Capability	S. K. Saini, Rachna Arya, Manish Sharma	Neelkanth Publication	

*Latest edition of all above books should be referred

(b) Open source software and website address:

1. nptel.iitm.ac.in/courses/.../IIT.../lecture%2023%20and%2024.htm
2. en.wikipedia.org/wiki/Shear_and_moment_diagram
3. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
4. www.engineerstudent.co.uk/stress_and_strain.html
5. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf

(c) Others:

1. Learning Packages
2. Users' Guide
3. Manufacturers' Manual



- A) **Course Code** : 2037C02BT037
 B) **Course Title** : Material Technology
 C) **Pre- requisite Course Code and Title** : None
 D) **Rationale** :

Engineering Materials play an important role for solving the problems of material selection and in the production and manufacturing. A diploma student must have the knowledge of properties, composition and behaviour of materials from the point of view of reliability and performance of the product. This curriculum is developed to impart the knowledge properties, structure and behaviour of materials applicable in most of the industries.

E) **Course Outcomes:**

- SO2.1 Interpret properties and structure of various engineering materials.
 SO2.2 Analyze the plastic deformation of metals.
 SO2.3 Interpret the phase diagrams.
 SO2.4 Select ferrous and non-ferrous materials as per the requirement.
 SO2.5 Select non-metallic materials as per the requirement.
 SO2.6 Select heat treatment process as per the requirement.

F) **Scheme of Studies:**

S.NO	Board of Studies (BOS)	Course (Subject)	Subject Code	Period per Week			Scheme of Examination			Total Marks	Credits	Teaching Hour	Assessment Hour
				L	T	P	Theory/Lab						
							ESE	CT	TA				
1	Mechanical	Materials Technology	2037C02BT037	2	1	-	100	20	20	140	3	45	15
2		Materials Technology (Lab)	2037C01BL037	-	-	2	40	-	20	60	1	30	15

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H) **Course-Curriculum Detailing:**

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Interpret properties and structure of various engineering materials.

(Approx. Hrs. : CI+LI+SW+SL=20)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Explain the properties of the given material.	LE1.1 Use Magnetic particle crack detector to detect internal crack in a given part/material.	Unit-1.0 Properties and Structure of Engineering Materials 1.1 History of Materials- An overview	● Effect of imperfections on material properties.



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.2 Describe with sketch the crystalline structure of a given material. SO1.3 Explain the effect of grain size on the properties of the given material. SO1.4 Identify the various types of imperfections in the figure or picture of the given material.	LE1.2 Use Dye penetration method to detect surface crack in a given part/material. LE1.3 Operate metallurgical Microscope to examine the given specimen. LE1.4 Macroscopic examination of constitution of a metal or an alloy in Relation to its physical and mechanical properties. LE1.5 Microscopy examination of constitution of a metal or an alloy in relation to its physical and Mechanical properties.	1.2 Recall Mechanical properties – stress, strain, strength, elasticity, ductility, brittleness, hardness, toughness, malleability, fatigue, creep, stiffness and Recall non-destructive tests. 1.3 Structure of crystalline solids: Difference between crystal structure and atomic structure, Concept of Amorphous and crystalline structure, Crystallization of liquid into solid state, nucleation and growth, formation of polycrystalline and single crystals, effect of grain size on material properties. 1.4 Crystal Structure – space lattice, unit cell, BCC, FCC, HCP lattice, Polymorphism and Allotropy. 1.5 Structural imperfections: impurity atoms, point imperfection, line imperfection, dislocations, surface imperfection, volume defects 1.6 Metallurgical microscope, its use and care	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Differentiate between atomic structure and crystal structure.
- Generate at least five ideas for recycling (a) metal tin (b) metal cans.
- Identify the materials used in the given artifacts. Why has a particular material been selected to be used in artifacts?

b. Mini Project:

- Prepare a model showing the crystal structure of different materials.
- Prepare models showing the different types of crystal structures.

c. Other Activities (Specify):

- Prepare a power point presentation on structural imperfections, their types and causes.

CO-2 Analyze the plastic deformation of metals.

(Approx. Hrs. : CI+LI+SW+SL=18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Explain the elastic and plastic deformation for the given material.	LE2.1 Perform Tension Test on mild steel/ Aluminum on	Unit-2.0 Plastic deformation 2.1. Elastic and of Plastic deformation	Effect of mechanical work on the structure and



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.2 Explain the phenomena of slip system in the FCC crystal. SO2.3 Co-relate strain hardening of the given material with the plastic deformation due to dislocations. SO2.4 Draw Stress-Strain curves for the given material. SO2.5 Calculate the relevant elastic, plastic, and fracture properties of the given materials from the stress-strain responses. SO2.6 Explain the process of recovery recrystallization and grain growth in the given material.	Universal Testing machine LE2.2 Perform Compression test on cast iron on Universal Testing Machine	2.2. Mechanisms of deformation in crystalline materials – Slip and Twinning 2.3. Stress – Strain curves for polycrystalline materials 2.4. Yield point phenomena 2.5. Strain hardening 2.6. Recovery, recrystallization and grain growth.	macro-properties of metals. • Slip system in various crystal structure

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Draw the stress-strain curves for different brittle and ductile materials.
- Suggest remedial measures for overcoming strain hardening.
- Explain the yield point phenomena and its importance.
- Identify important stages in recrystallization process.
- Prepare a power point presentation showing the different mechanisms of plastic deformation.
- Prepare a power point presentation on “Carpet Analogy” to understand the weakening of a crystal due to dislocations.
- Collect videos from websites on plastic deformation to understand the mechanism of deformation and give the seminar on the topic.

CO-3 Interpret the Phase diagrams.

(Approx. Hrs. : CI+LI+SW+SL=20)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1. Interpret the given phase diagram. SO3.2. Distinguish between given types of solid solutions. SO3.3. Plot cooling curve for a given material. SO3.4. Interpret Iron-Carbon equilibrium diagram. SO3.5. Identify the micro structure of the given metal with the help of	LE3.1. Polish and etch low-carbon steel samples to reveal the equilibrium phase distribution. LE3.2. Use Metallurgical Microscope to identify different phases of the given material. LE3.3. Identify the effect of non-equilibrium cooling rates on microstructure.	Unit-3.0 Phase diagrams 3.1. Concept, definitions and need 3.2. Solid Solution – Types 3.3. Alloy – need for alloying, effect on material properties 3.4. Types of phase equilibrium diagram - Monotectoid, Eutectic, Hyper eutectic, hypoeutectic, eutectoid, Hyper and Hypo eutectoid, peritectic and peritectoid system.	• Lever Rule, determining amount of phases present



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
pictures with justification SO3.6 Identify the metal from the given picture of microstructure with justification		3.5. Iron-carbon equilibrium diagram: Development of microstructure in Iron – Carbon system, Allotropic transformations in Iron and Steel 3.6. Microstructure examination: Preparation of micro-specimen, selecting the specimen, grinding and polishing, Etching and etching reagents. use and care of microscope	

SW-4 Suggested Sessional Work (SW):**a. Assignments:**

- Apply Gibbs Phase rule to determine the degrees of freedom or number of phases present in a given phase diagram.
- Explain the different type of solid solutions.
- Alloying elements can be used to improve the properties of pure metals, justify?
- Locate eutectic, peritectoid and eutectoid points in the iron-carbon equilibrium diagram.
- Plot the cooling curve for different materials.
- Identify the allotropic forms of pure iron with their crystal structures and corresponding temperatures.
- Analyze and identify the phases present in the given alloy system from the phase diagram.

b. Mini Project:

- Collect the sample of different metallic component and determine the microstructure of different metallic components using metallurgical microscope and compare their microstructure.
- Experimental determination of the Pb-Sn phase diagram by analyzing cooling curves.
- Determine the composition of given samples by comparing quantitative metallography of polished and etched samples to the equilibrium Fe-Fe₃C phase diagram.

CO-4 Select ferrous and non-ferrous materials as per the requirement.

(Approx. Hrs. : CI+LI+SW+SL=18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Select relevant steel and cast iron for the given application. SO4.2 Select relevant non-ferrous material for the given application. SO4.3 Interpret material designations.	LE4.1. Use Metallurgical Microscope to determine the Micro structure of given alloy. LE4.2 Use Metallurgical Microscope to determine Micro structure of given steel.	Unit-4.0 Metallic Materials Properties and application, designation of: 4.1. Cast Iron: Gray, White, Malleable, Nodular Cast iron. 4.2. Steels: Low, medium and high carbon steels, Stainless steel, High speed steel, Tool steel, Alloy steels	- Micro- Structure, Properties and application, the PIG iron, Wrought iron - Explain about different Commercial use of steels like forms/shapes of steels- plate, rod, channel, angle,



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
		4.3. Copper, Aluminum, Zinc and their alloys, Bearing materials, 4.4. Alloying elements and their effects.	T-section, Z-section ● Properties and applications of Tin, Lead etc.

SW-4 Suggested Sessional Work (SW):**a. Assignments:**

- Identify various ferrous metals and alloys based on their composition and properties for given applications.
- Identify at least 5 metallic components for a given machine / assembly. Also list the material of identified machine / assembly components.

b. Mini Project:

- Collect at least 10 machine parts made of metals and alloys (Copper, brass, aluminum, cast iron, high speed steel etc.), identify its properties, its structure and its application and prepare a report.

CO-5 Select non-metallic materials as per the requirement.

(Approx.HrsCI+LI+SW+SL=10)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Select relevant polymers for the given application with justification. SO5.2 Select relevant refractory material for the given application with justification SO5.3 Select relevant composite material for the given application with justification. SO5.4 Explain the type and applications of Nano and Smart materials.	LE5.1. Characterize the mechanical behavior of Teflon, a polymer, and identify its special characteristics as compared with metals.	Unit-5.0 Non-metallic Materials 5.1. Polymers: Types, properties and industrial applications 5.2. Ceramic and refractory: Types, properties and applications 5.3. Composites: types, properties and applications. 5.4. Nano and Smart materials: Definition, types- piezoelectric.	● Identification codes of plastics ● Confirmation tests for thermoplastics and thermosetting plastics.

SW-5 Suggested Sessional Work (SW):**a. Assignments:**

- Identify various polymers based on their composition and properties for given applications.
- Compare of Nano and smart materials with composites.
- Identify at least 5 Nonmetallic components for a given machine / assembly. Also list the material of identified machine / assembly.
- Identify and list nonmetallic Materials used for construction of common home appliances like mixer grinder, washing machine, refrigerator, electric iron, etc.
- Write composition, properties and industrial applications of important plastics.

b. Mini Project:



- Collect at least 10 machine parts made of non-metals and identify its properties, its structure and its application and prepare a report.
- Select five different plastics samples and then categorize them by performing experiments based on burning test.

CO-6 Select relevant heat treatment processes.

(Approx. Hrs. : CI+LI+SW+SL=20)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO6.1 Interpret TTT curves. SO6.2 Explain Pearlite, Bainitic and Martensitic Transformation for the given material SO6.3 Select relevant heat treatment processes for the given material or application with justification.	LE6.1. Operate heat treatment furnace. LE6.2. Use muffle /box type furnace to Determine the effect of following quenching media on the hardness of mild steel: Oil, Water, Brine	Unit-6.0 Heat treatment of Steels 6.1 Introduction, purpose and advantage of heat treatment 6.2 TTT Curve: Significance and construction of TTT curve for eutectoid steel 6.3 Introduction to Pearlite, Bainitic and Martensitic Transformation 6.4 Heat treatment processes, purpose and applications: Annealing, Normalizing, Hardening, Tempering, Surface and Case hardening 6.5 Heat treatment furnaces: Muffle furnace, Box type furnace	• Heat treatment of tool steel and high speed steel

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Explain the importance of TTT curves.
- Can heat treatment improves the material properties, justify?
- Compare the different heat treatment processes
- Select appropriate heat treatment process for given application with justification.
- Explain the effect of cooling rate in hardening.

b. Mini Project:

- Visit at least two industry which has specifically heat treatment facilities and prepare a report consisting of:
 - Types of heat treatment process
 - Types of furnaces
 - Types of quenching mediums used
 - Types of Testing equipment's
 - Safety precautions observed.

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Properties and Structure of Engineering Materials	3	6	6	15
II	Plastic Deformation	3	6	10	19



III	Phase Diagrams	3	4	8	15
IV	Metallic Materials	3	4	8	15
V	Non-metallic materials	3	4	8	15
VI	Heat treatment of Steels	3	6	12	21
Total		18	30	52	100

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laborator y Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Use Magnetic particle crack detector to detect internal crack in a given part/material.	15	10	5
LE1.2	Use Dye penetration method to detect surface crack in a given part/material.	15	10	5
LE1.3	Operate metallurgical microscope to examine the given specimen.	15	10	5
LE1.4	Macroscopy examination of constitution of a metal or an alloy in relation to its physical and mechanical properties.	15	10	5
LE1.5	Microscopy examination of constitution of a metal or an alloy in relation to its physical and mechanical properties.	15	10	5
LE2.1	Perform Tension Test on mild steel/ Aluminum on Universal Testing machine as per IS432 (I).	15	10	5
LE2.2	Perform Compression test on cast iron on Universal Testing Machine as per IS 14858.	15	10	5
LE3.1	Polish and etch low-carbon steel samples to reveal the equilibrium phase distribution	15	10	5
LE3.2	Use Metallurgical Microscope to identify different phases of the given material.	15	10	5
LE3.3	Identify the effect of non-equilibrium cooling rates on microstructure	15	10	5
LE4.1	Use Metallurgical Microscope to determine the Micro structure of given alloy.	15	10	5
LE4.2	Use Metallurgical Microscope to determine Micro structure of given steel.	15	10	5
LE5.1	Characterize the mechanical behavior of Teflon, a polymer, and identify its special characteristics as compared with metals	15	10	5
LE6.1	Operate heat treatment furnace.	15	10	5
LE6.2	Use muffle /box type furnace to Determine the effect of following quenching media on the hardness of mild steel d. Oil, Water, Brine	15	10	5

* Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical's

Legend: PRA: Process Assessment, PDA: Product Assessment

Note: Only one experiment has to perform at the end semester examination of **30 Marks** as per assessment scheme.

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method



4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:**(a) Books :**

S.N.	Title	Author	Publisher	Edition & Year
1.	Material Science and Metallurgy	O. P. Khanna	Dhanpat Rai & Sons	ISBN: 9788189928315
2.	Materials Science and Metallurgy	R. K. Rajput	S. K. Kataria & Sons	ISBN: 9789350144183
3.	Materials Science & Engineering	V. Raghvan	PHI	ISBN: 8120324552
4.	Materials Science	R. S. Khurmi	S Chand	ISBN: 9788121901468
5.	Materials Science	G. K. Narula, K. S. Narula, V. K. Gupta	TMH	ISBN: 0074517961
6.	Material Science & Metallurgy	U. C. Jindal	Pearson	ISBN: 9788131759110
7.	Fundamentals of Materials Science & Engineering	William D. Callister David G Rethwisch	Jhon Wiley & Sons	ISBN : 13 9781118287989
8.	Padarth Vigyan evam Engineering (Materials Science and Engineering)	V. D. Sharma, R. P. Garg	Standard Publishers	ISBN : 8180141136
9.	Material Science and Engineering	Neha Sharma, Priyanka Gupta	Neelkanth Publishers	ISBN: 9789390582679

(b) Open source software and website address:

1. NPTEL Course- <http://nptel.ac.in/courses/113106032/>
2. Plastic deformation -<https://www.youtube.com/watch?v=Oz8fW68RY6I>
3. Properties and Structure of Engineering Materials-
https://www.youtube.com/watch?v=uG35D_euM-0
4. Plastic deformation- <https://www.youtube.com/watch?v=Oz8fW68RY6I>
5. Phase diagrams- <https://www.youtube.com/watch?v=m9O2LzwnxsY>
6. Metallic Materials
<https://www.youtube.com/watch?v=uh4obOPltpw&list=PL8bFJyqxQ9otr7r3gGoZ2Hvl-3c8q6Q8A>
7. Non-metallic Materials- <https://www.youtube.com/watch?v=ssLOujezkxo>
8. Heat treatment of Steels-<https://www.youtube.com/watch?v=Jt8pYX4nVS0>
9. Testing of Materials
https://www.youtube.com/watch?v=tpGhqQvftAo&list=PL1XvQlloG76jRFOxUiWAcM_YrMUf4Bs_nSX

M) List of Major Laboratory Equipment and Tools:



S.N.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Metallurgical Microscope	6V, 30 W Halogen light, 200x magnification, wide field eyepiece, trinocular head, mechanical stage.	1.3, 1.5, 3.2, 4.1, 4.2
2	Grinding machine for rough polishing	Single phase, belt driven, ½ HP, manually operated	3.1
3	Double disc variable speed polishing machine (Automatic Polishing Machine can also be considered)	Digital, double disc, variable speed 50 – 1400 rpm control by potentiometer	3.1
4	Standard steel specimens for microscopic examination	Standard specimens of different types of steel	3.1
5	Standard Cast Iron specimens for microscopic examination	Standard specimens of different types of cast iron	3.1, 3.2
6	Universal Testing Machine	Universal Testing Machine: Capacity - 100 tones. Type: Mechanical type digital, electrically Operated. Accessories: (1) Tensile test attachment for flat and round specimen up to 32 mm. (2) Compression test attachment (3) Shear test attachment with sizes of bushes 5, 6, 8, 10, 12, 16, 20, 24 mm, (4) Transverse test attachment with bending Punch, (5) Service tools, (6) Operation and maintenance manuals - 2 nos. (7) Hardness attachment Digital Extensometer: Least count - 0.001 mm. Max. Extension = 5 mm. Single dial gauge for 30, 40 mm, 60 mm, 80 mm, 100 mm, 125 mm gauge Length.	2.1, 2.2
7	Heat treatment furnace (Muffle/Box type)	Max temperature 1400°C, digital temperature control, 220V with necessary accessories like gloves, tongs etc.	6.1, 6.2
8	Magnetic particle crack detector	Operating on single phase 230V supply suitable for laboratory use with all standard accessories and consumables	1.1
9	Dye penetration test kit	Suitable for laboratory purposes with all standard accessories and consumables	1.2



N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2	PSO-3
c. Interpret properties and structure of various engineering materials.	2	3	3	2	-	1	-	1	1	1	-	-	3
CO-2 Analyze the plastic deformation of metals.	2	3	3	2	-	-	-	1	1	1	-	-	3
CO-3 Interpret the phase diagrams.	2	3	3	2	-	-	-	1	1	1	-	-	3
CO-4 Select ferrous and non ferrous materials as per the requirement.	2	3	3	2	-	1	-	1	1	2	-	-	3



Semester-III

CO-5 Select non-metallic materials as per the requirement	2	3	3	2	-	1	-	1	1	2	-	-	3
CO-6 Select heat treatment process as per the requirement	2	3	3	2	-	1	-	1	1	2	-	-	3
CO-7 Select relevant material testing method.	2	3	3	2	-	1	-	1	1	2	-	-	3

Legend: 1 – Low, 2 – Medium, 3 – High

**O) Course Curriculum Map:**

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,4,6, 8,9,10 PSO-3	CO-1 Interpret properties and structure of various engineering materials.	SO1.1, SO1.2 SO1.3, SO1.4 SO1.5, SO1.6	LE1.1, LE1.2, LE 1.3, LE 1.4, LE 1.5	Unit 1.0 Properties and Structure of Engineering Materials 1.1, 1.2, 1.3, 1.4, 1.5, 1.6	As mentioned
PO-1,2,3,4,8, 9,10 PSO-3	CO-2 Analyze the plastic deformation of metals.	SO2.1, SO2.2 SO2.3, SO2.4 SO2.5, SO2.6	LE2.1, LE2.2, LE2.3, LE2.4, LE2.5, LE2.6	Unit 2.0 Plastic Deformation 2.1, 2.2	
PO-1,2,3,4,8, 9,10 PSO-3	CO-3 Interpret the phase diagrams.	SO3.1, SO3.2 SO3.3, SO3.4 SO3.5, SO3.6	LE3.1, LE3.2, LE3.3	Unit 3.0 Phase Diagrams 3.1, 3.2, 3.3, 3.4, 3.5, 3.6	
PO-1,2,3,4,6, 8,9,10 PSO-3	CO-4 Select ferrous and non-ferrous materials as per the requirement.	SO4.1 SO4.2 SO4.3	LE4.1 LE4.2	Unit 4.0 Metallic Materials 4.1, 4.2, 4.3, 4.4	
PO-1,2,3,4,6, 8,9,10 PSO-3	CO-5 Select non-metallic materials as per the requirement	SO5.1, SO5.2 SO5.3, SO5.4	LE5.1	Unit 5.0 Non-metallic materials 5.1, 5.2, 5.3, 5.4	
PO-1,2,3,4,6, 8,9,10 PSO-3	CO-6 Select heat treatment process as per the requirement	SO6.1 SO6.2 SO6.3	LE6.1 LE6.2	Unit 6.0 Heat treatment of steels 6.1, 6.2, 6.3, 6.4, 6.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning



Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Mechanical Engineering (NEP)

Semester-III

- A) Course Code : 2037C03BT037
 B) Course Title : Thermal Engineering
 C) Pre-requisite Course Code and Title : None
 D) Rationale :

Thermal Engineering incorporates the basic principles of thermodynamics and its application. As large number of engineering processes involve with exchange of energy, so the knowledge of thermal engineering is essential to deal with all above processes. Thermal Engineering is the core subject of mechanical stream as its application includes various fields of engineering application. Present curriculum has been developed to enable the students to efficiently handle the relevant day to day situation arising in their field of working.

E) Course Outcomes:

CO1- Apply the fundamentals of thermodynamics to various thermodynamic systems and devices.

CO2- Apply second law of thermodynamics to a given thermodynamic system.

CO3- Investigate the performance parameters of IC engines.

CO4- Analyze the properties of the steam.

CO5- Apply the gas laws to the given situation/application.

CO6- Select relevant heat exchanger as per the requirement

F) Scheme of Studies and Assessment :

S. N O	Board of Studies (BOS)	Course (Subject)	Subject Code	Period per Week			Scheme of Examination			Total Marks	Credits	Teaching Hour	Assessment Hour
				L	T	P	Theory/Lab						
							ESE	CT	TA				
1	Mechanica	Thermal Engineering	2037C03BT037	2	1	-	100	20	20	140	3	45	15
2		Thermal Engineering (lab)	2037C02BL037	-	-	2	40	-	20	60	1	30	15

Legend: L: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), P: Laboratory Instruction (Includes Practical performances in laboratory/ workshop, field or other locations using different instructional strategies), ESE: End Semester Examination, CT: Class Test, TA: Teachers Assessment (Sessional Work includes assignment, seminar, minor project etc.)

H) Course-Curriculum Detailing:



This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

Convert unit of the given physical quantity from one unit system to other.

CO-1: Apply the fundamentals of thermodynamics to various thermodynamic systems and Devices

(Approx. Hrs. : CI+LI+SW+SL=12)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Identify the different thermodynamic systems. SO1.2 Apply First law of thermodynamics to a given thermodynamic system to calculate work and heat transfer. SO1.3 Apply second law of thermodynamics to a given thermodynamic system. SO1.4 Find the entropy change in a given situation.	.1 Determine the rise in temperature of air due to external work using an air compressor test rig. LE1.2 Determine the coefficient of performance of heat pump.	Unit-1.0 Basics Concepts of thermodynamics 1.1 Basic Definitions: Definition and importance of Thermodynamics, Thermodynamic systems, Thermodynamic properties, Work, heat and energy, Thermodynamic equilibrium, Quasi-static process, work done during Quasi-static process, Zeroth law of Thermodynamics 1.2 Applications of First law of thermodynamics - steady flow energy equation and its applications to boiler, engine, turbine, compressor and nozzle. 1.3 Thermodynamic processes and representation on P-V and T-S diagram, Simple Numerical problem on First law of thermodynamics. 1.4 Second Law of Thermodynamics - Limitations of First law of thermodynamics, Second law of thermodynamics: Kelvin Planck's and Clausius statements, Heat reservoir, Heat source and Heat sink, Concept of heat engine, heat pump and refrigerator, Carnot cycle, Thermal efficiency, Coefficient of performance, Parameters affecting thermal efficiency, Means of increasing efficiency, Thermodynamically reversible and irreversible processes, Factors that makes a process irreversible. 1.5 Entropy- Clausius inequality, concept of Entropy, Principle of increase of entropy,	● Availability and unavailability ● Third Law of thermodynamics.



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
		T-S and H-S diagrams, computation of change in entropy	

SW-1 Suggested Sessional Work (SW):**a. Assignments:**

- List the devices which convert heat in to work.
- List the real life example of open and closed system.
- List the Devices working on basis of first law of thermodynamic.
- Draw the given thermodynamic process on HS diagram.
- Deduce the relation between COP of heat pump and refrigerator
- Write the limitation of Carnot cycle.

b. Mini Project:

- Verify the steady flow energy equation for nozzle and turbine for a set of given data/ by data collected from laboratory/industry.
- Verify the steady flow energy equation for Pump and Condenser by data collected from laboratory/industry.
- Investigate the energy transfer in an IC engine.

SW-1 Suggested Sessional Work (SW):**a. Assignments:**

- Deduce the relation between COP of heat pump and refrigerator
- Write the limitation of Carnot cycle.

b. Mini Project:

- Verify the steady flow energy equation for nozzle and turbine for a set of given data/ by data collected from laboratory/industry.
- Verify the steady flow energy equation for Pump and Condenser by data collected from laboratory/industry.
- Investigate the energy transfer in an IC engine.

CO-2 Apply the gas laws to the given a situation/application.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Determine the change in properties of gases in the given process. SO2.2 Calculate the mass of a gas and its final condition parameters from the given process. SO2.3 Calculate different energy changes during ideal gas processes.	LE2.1 Determine the characteristic Gas constant of commonly used gases from given data.	Unit-2.0 Ideal Gases and Ideal Gas Processes 2.1 Avogadro's law, Derivation of characteristic gas equation using Boyle's and Charle's law, characteristic gas constant and universal gas constant. , simple numerical problems based on above.	• Mixture of gases – Dalton's law of partial pressure.



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.4 Determine the Characteristics Gas Constant of commonly used gases from given data.		2.2 Ideal gas processes – Isobaric, Isochoric, Isothermal, Isentropic, Polytropic, Throttling and their representation on P-V and T-S diagrams, determination of work, heat, internal energy, enthalpy change and entropy change.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Identify and list the application of gases in industries.
- Explain the change in properties of air during throttling in throttling valve.
- Identify and justify the various thermodynamic process involved in petrol and diesel engines.

CO-3 Investigate the performance parameters of IC engines.

(Approx. Hrs. :

CI+LI+SW+SL=19)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1. Interpret given Air Standard Cycles. SO3.2. Represent the given air standard cycles on PV and TS diagrams. SO3.3. Identify the components from the given IC engine cut section model/picture and explain their functions. SO3.4. Explain the working of the given engines with sketches. SO3.5. Calculate different performance parameters of the given IC engine(s). SO3.6. Calculate IP, BP, FP, Thermal Efficiency, Mechanical	3.1. Determine the BP of four strokes diesel engine using brake dynamometer. 3.2. Determine the BP of four strokes Petrol engines using brake dynamometer. 3.3. Perform load test on 2 stroke single petrol engine.	Unit-3.0 Air Standard Cycles and internal combustion engines 3.1 Air standard cycles-definition and its purpose, Otto, Diesel cycles, their representation on PV & TS diagrams, Derivation of air standard efficiency and their comparison and limitation. 3.2 Internal Combustion engines Introduction and classification of IC engine, I.C. engine components and their function, Working of two-stroke and four stroke cycle engines and their comparison, 3.3 Indicator diagram, calculation of IP, BP, FP, Thermal Efficiency, Mechanical efficiency and relative efficiency.	- Dual cycle, Ericson cycle, Sterling cycle. - Sterling Engine



Chhattisgarh Swami Vivekanand Technical University, Bhilai

Diploma in Mechanical Engineering (NEP)

Semester-III

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
efficiency and relative efficiency from the given data.			

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Compare the different air standard cycles.
- Draw the air standard cycles on HS diagram.
- List the applications of different IC engines.
- Compare the petrol and diesel engines.

b. Mini Project:

- Dismantle two stroke and four stroke petrol engines and compare their construction /components.
- Prepare a report on engine's performance parameters of various commercial available passenger and goods carrying vehicles.

CO-4 Analyze the properties of the steam.

(Approx. Hrs. : CI+LI+SW+SL=15)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.4 Calculate the heat required to convert the given sample of water into steam of desire quality SO3.5 Calculate the dryness fraction of given sample of steam data. SO3.6 Represent different vapor processes on different planes in a given situation	LE4.1 Determine the dryness fraction of given sample of steam using separating and throttling calorimeter. LE4.2 Plot the steam properties on h-s diagram (Mollier diagram) for a given sample of steam.	Unit-4.0 Pure substances 4.1 Pure substance, phase, phase changes, steam as a two phase system, steam formation and its representation on the enthalpy plane 4.2 Representation of wet, dry and saturated and superheated steam on PV,T-S and H-S planes, Dryness fraction of steam 4.3 Simple calculations on quality of steam using Steam table and Mollier diagram.	• Calculation of entropy and enthalpy.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Write the importance of steam quality.
- Justify the use of superheated steam in power plant.



b. Mini Project:

- Visit a nearby power plant and collect the data related to properties of steam at various locations i.e. boiler inlet and exit, turbine inlet and exit, condenser inlet and exit etc. and use it to calculate the changes in quality, enthalpy and entropy of steam

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

CO-5 Select relevant air compressor as per requirement.

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Describe the suitability of given compressor for given Applications. SO5.2 Select compressor for the given application with justification. SO5.3 Describe the working and construction of the given Compressor. SO5.4 Calculate work done and efficiencies of compressor.	LE5.1 Determine the performance parameters of a Reciprocating Compressor/Centrifugal compressor. LE 5.2 Determine the capacity of the given reciprocating air compressor.	Unit-5.0 Air Compressors 5.1 Basics of compression , industrial uses of compressed air 5.2 Classification of compressors, Description of reciprocating compressor and Centrifugal compressor, Work done in single stage reciprocating compressor, Volumetric, Isothermal and Isentropic efficiencies of reciprocating air compressor 5.3 Multistage compression and inter cooling and advantages. 5.4 Safety precautions in handling compressed air.	Axial Flow Compressor

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- List the industrial uses of Compressed air.
- List the advantages of intercooling.
- List the commercial uses of reciprocating compressor.

b. Mini Project:

- Prepare a report on the domestic, industrial and field application of compressors, its type, its specifications etc.

CO-6 Identify the mode of heat transfer in a given situation.

(Approx. Hrs. : CI+LI+SW+SL=19)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO6.1 Selects the modes of heat transfer for the given situation with justification.	LE6.1 Determine Thermal conductivity of a solid metallic rod/plate.	Unit-6.0 Heat Transfer 6.1 Modes of heat transfer Conduction, convection and radiation. terms related to heat transfer -	● Automotive heat exchangers



Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO6.2 Calculate heat transfer through conduction for the given situation. SO6.3 Determine the heat transfer through convection in the given situation. SO6.4 Calculate the amount of heat transfer through Radiation in the given situation. SO6.5 Select heat exchanger as per given situation with justification	LE6.2 Determine thermal conductivity of a given insulating powder. LE6.3 Determine the value of Stefan-Boltzmann constant for radiation	thermal conductivity, Heat transfer coefficient, thermal diffusivity, heat flux, thermal resistance, Fourier's law of heat conduction, 6.4 Convection- Newton's law of cooling, natural and forced convection, engineering applications/examples. 6.5 Radiation-Stefan-Boltzmann law of thermal radiation, absorptivity, reflectivity, transmissivity, emissivity, Black body, Grey body, Emissive power, engineering applications/examples.	

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Identify the modes of heat losses in the various parts of the boiler.
- Compare parallel and counter flow heat exchanger.

b. Mini Project:

- Visit a nearby power plant and identify the modes of heat loss from various components and write a report.
- Identify the modes of heat loss in an IC engine.
- Prepare a power point presentation on various types of heat exchangers.

I) Suggested Specification Table (For ESE of Classroom Instruction):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Basic Concepts of thermodynamics	4	5	10	19
II	Ideal Gases and Ideal Gas Processes	4	5	10	19
III	Air Standard Cycles and Internal Combustion Engines	3	5	10	18
IV	Pure substance	3	3	10	16
V	Air Compressors	3	3	8	14
VI	Heat Transfer	3	3	8	14



Total	20	24	56	100
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Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESE of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Determine the rise in temperature of air due to external work.	15	10	5
LE1.2	Determine the coefficient of performance of heat pump.	15	10	5
LE 2.1	Determine the BP of four strokes diesel engine using brake dynamometer.	15	10	5
LE2.2	Determine the BP of four strokes Petrol engines using brake dynamometer.	15	10	5
LE2.3	Perform load test on 2 stroke single petrol engine.	15	10	5
LE3.1	Determine the dryness fraction of given sample of steam using separating calorimeter.	15	10	5
LE3.1	Plot the steam properties on h-s diagram (Mollier diagram) for a given sample of steam.	15	10	5
LE4.1	Determine the Characteristics Gas Constant of commonly used gases from given data.	15	10	5
LE5.1	Determine the performance parameters of a Reciprocating Compressor/Centrifugal compressor.	15	10	5
LE5.2	Determine the capacity of the given reciprocating air compressor.	15	10	5
LE6.1	Determine Thermal conductivity of a solid metallic rod/plate.	15	10	5
LE6.2	Determine thermal conductivity of a given insulating powder.	15	10	5
LE6.3	Determine the value of Stefan-Boltzmann constant for radiation	15	10	5

*Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practical's.

Legend: PRA: Process Assessment, PDA: Product Assessment

K) Suggested Instructional/Implementation Strategies:

- Improved Lecture
- Tutorial
- Case Method
- Group Discussion
- Industrial visits
- Industrial Training
- Field Trips



- viii. Portfolio Based Learning
- ix. Demonstration
- x. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
- xi. Brainstorming
- xii. Others

L) Suggested Learning Resources:**(a) Books :**

S. N.	Titles	Author	Publisher	Edition & Year
1	A text book of Thermal Engineering	R.S.Khurmi,	S.Chand	ISBN-10: 8121925738
2	A Course in Thermal Engineering.	R.K. Rajput	Laxmi Publication, Dariya ganj, New Delhi	ISBN 13: 9788131808047
3	Engineering Thermodynamics	P.K. Nag	Tata McGraw Hill	ISBN: 9781259062568
4	Fundamentals of Engineering Thermodynamics	E Radhakrishnan	PHI	ISBN: 9788120327900
5	Thermodynamics	Prasanna Kumar	Pearson	ISBN: 9789332514133
6	Thermal Engineering (Tapiya Abhiyantriki)	S.S.L. Patel	Standard Publishers Distributors, Delhi.	ISBN- 9788180141669
7	Introduction to Thermodynamics	Y. V. C. Rao	Universities Press	ISBN: 9788173714610
8	Applied Thermodynamics	R. Yadav	Central Publishing House	ISBN:818544403X
9	Thermal Engineering	S. S. L. Patel	Standard Publishers	ISBN: 9788180141669
10	Thermal Engineering	J. M. L. Gupta	Bharat Bharti Prakashan & Co	

(b) Open source software and websiteaddress:

- i. Thermodynamic properties - <https://www.youtube.com/watch?v=mdVmzfzSMPrw>
- ii. NPTEL Couses- <http://nptel.ac.in/courses/112105123/>
- iii. 1st law of thermodynamics - <https://www.youtube.com/watch?v=YvQp2qy5l60>
- iv. 2nd law of thermodynamics <https://www.youtube.com/watch?v=vPcjOHCPoqQ>
- v. Entropy- https://www.youtube.com/watch?v=DtS_hc09ozI
- vi. internal combustion engine - <https://www.youtube.com/watch?v=vIJ50aUiBgM>
- vii. pure substance-<https://www.youtube.com/watch?v=Ig1Fc3pXSLQ>
- viii. gases and gase mixture- <https://www.youtube.com/watch?v=uFwFxxgWdm5U>
- ix. air compressor-<https://www.youtube.com/channel/UCRgblwOwpVFdzMzPbs88kGg>
- x. heat transfer- <https://www.youtube.com/watch?v=K4rZgt9ZYuE>

(c) Others:



- i. Learning Packages.
- ii. Lab Manuals.
- iii. Manufacturers' Manual
- iv. Users' Guide

M) List of Major Laboratory Equipment and Tools:

S. No.	Name of Equipment	Broad Specifications*	Relevant Experiment No.
1	Heat pump test rig	A test rig consist of hermetically sealed compressor fitted with energy meter , heat rejection chamber expansion device and heat absorption chamber, digital temperature indicator to display temperature at various location.	LE1.2
2	Single cylinder Four stroke diesel engine test rig	Rated power= 5 H.P. or more Rated speed = 1500 RPM Diameter of bore= 80 MM Stroke length= 110 MM Fuel= Diesel	LE2.1
3	Single cylinder Four stroke petrol engine test rig	Rated power= 5 H.P. or more Rated speed = 1500 RPM Diameter of bore= 80 MM Stroke length= 110 MM Fuel= Petrol	LE 2.2
4	Load test apparatus for measuring bp of petrol engine	Dynamometer type= rope brake dynamometer Rated power= 5 H.P. or more Rated speed = 1500 RPM Diameter of bore= 80 MM Stroke length= 110 MM Fuel= petrol.	LE2.3
5	Separating and throttling Calorimeter	Complete set up for measuring the dryness fraction of steam consisting of Separating Chamber made of Stainless Steel insulated with Ceramic Wool with water level indicator, Throttling Chamber provided with gauge to measure inlet pressure before throttling, Heat Exchanger for condensing steam after throttling chamber Steam Generator, Flow, pressure and temperature measuring sensors.	LE3.1
6	Reciprocating air compressor test rig	Two stage reciprocating air compressor Motor- electric motor Steel supply tank and measuring tank, Electric supply- 230 v Speed- 1000 rpm, suitable tapings for pressure and temperature measurement.	LE 5.1, 5.2
7	Centrifugal compressor test rig.	Centrifugal compressor Motor- electric motor Steel supply tank and measuring tank, Electric supply- 230 v	LE 5.1



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S. No.	Name of Equipment	Broad Specifications*	Relevant Experiment No.
8	Thermal conductivity of metal rod equipment	Speed- 1000 rpm Type – digital Accuracy- 0.05 % Thermostat- digital Heater- electric Power- 500 w or more	LE6.1
9	Thermal conductivity of insulating powder equipment.	Inner sphere- 100 mm dia material copper Outer sphere – 200 mm dia material copper Heater – round type temperature indicator- Digital	LE6.2
10	Experimental set up to verify Stefan Boltzman law.	Metal bar- copper Heater – round type temperature indicator- Digital heat input- 2A, 230 V	LE 6.3

* The specifications shown above are suggestive only.



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N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2	PSO-3
CO-1 Apply the fundamentals of thermodynamics to various thermodynamic systems and devices	3	3	3	-	-	-	-	1	1	2	-	-	3
CO-2 Investigate the performance parameters of IC engines.	3	3	3	3	3	2	-	1	1	2	-	-	3
CO-3 Analyze the properties of the steam.	3	3	3	3	3	-	-	1	1	2	-	-	3
CO-4 Apply the gas laws to the given situation/application	3	3	3	-	-	-	-	1	1	2	-	-	3
CO-5 Select relevant air compressor as per the requirement	3	3	3	3	2	-	-	1	1	2	-	-	-



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CO-6 Select relevant heat exchanger as per the requirement	3	3	3	3	-	-	1	1	2	-	3
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Legend: 1 – Low, 2 – Medium, 3 – High



O) Course Curriculum Map:

POs & PSOs No.	COs No. & Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO-1,2,3,8,9,10 PSO-3	CO-1 Apply the fundamentals of thermodynamics to various thermodynamic systems and devices	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2 LE1.3	Unit-1.0 Basics Concepts of thermodynamics 1.1, 1.2, 1.3, 1.4, 1.5	As mentioned in page number 191 to 197
PO-1,2,3,4,5,6,8,9,10 PSO-3	CO-2 Investigate the performance parameters of IC engines.	SO2.1, SO2.2 SO2.3, SO2.4 SO2.5, SO2.6	LE2.1 LE2.2 LE2.3	Unit-2.0 Air Standard Cycles and internal combustion engines 2.1, 2.2, 2.3	
PO-1,2,3,4,5,8,9,10 PSO-3	CO-3 Analyze the properties of the steam.	SO3.1 SO3.2 SO3.3	LE3.1	Unit-3.0 Pure Substances 3.1, 3.2, 3.3 3.4	
PO-1,2,3,8,9,10 PSO-3	CO-4 Apply the gas laws to the given situation/application	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4.0 Ideal Gases 4.1 4.2	
PO-1,2,3,4,5,8,9,10 PSO-3	CO-5 Select relevant air compressor as per the requirement	SO5.1 SO5.2 SO5.3	LE5.1 LE5.2	Unit-5.0 Air Compressors 5.1, 5.2, 5.3, 5.4,	
PO-1,2,3,4,8,9,10 PSO-3	CO-6 Select relevant heat exchanger as per the requirement	SO6.1 SO6.2 SO6.3 SO6.4 SO6.5	LE6.1 LE6.2 LE6.3	Unit-6. Heat Transfer 6.1, 6.2, 6.3 6.4, 6.5	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.



A. Course Code : 2037C04CT037

B. Course Title : Machine Drawing and Computer Aided Drafting

C. Pre-requisite Course Code and Title : None

D. Rationale :

The students of mechanical engineering programme are mainly involved in manufacturing, inspection and planning activities such as preparing process plans, preparing bill of materials, etc., in industries. For all such activities, reference document is the drawing of component/assembly to be manufactured. In this context, it is of utmost importance to prepare, read and interpret these drawings correctly for production of components and assemblies accurately. The industrial practices of machine drawing are also important for the students to make them aware of Drafting practices, symbols, codes, norms and standards generally used in industries. In first Semester engineering drawing course one unit was devoted for drawing 2D geometric entities using computer aided drafting software to develop the basic drafting skills and knowledge. Now in this course use of same software is further extended for the development of Isometric and orthographic drawings of simple machine components.

E. Course Outcomes:

CO-1: Draw curves of intersection of different regular solids.

CO-2: Draw the development of surfaces of various regular solids.

CO-3: Use various drawing codes, conventions and symbols as per IS SP-46.

CO-4: Use limits-fits-tolerances, surface finish and welding symbols and values in production

Drawings

CO-5: Prepare exploded views from assembly drawing of machine component.

CO-6: Prepare assembly drawings from exploded views of machine component.

CO-7: Draw isometric and orthographic sectional views of simple machine elements manually and using computer aided drafting software.

F. Scheme of Studies:

1. Scheme of Studies.													
S. NO.	Board of Studies (BOS)	Course (Subject)	Subject Code	Period per Week			Scheme of Examination			Total Marks	Credits	Teaching Hour	Assessment Hour
				L	T	P	Theory/Lab						
							ESE	CT	TA				
1	Mechanical	Machine Drawing and Computer Aided Drafting	2037C04CT037	2	1	-	100	20	20	140	3	45	15
2		Machine Drawing and Computer Aided Drafting (lab)	2037C03CL037	-	-	2	40	-	20	60	1	30	15



Legend: L: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), P: Laboratory Instruction (Includes Practical performances in laboratory/workshop, field or other locations using different instructional strategies), ESE: End Semester Examination, CT: Class Test, TA: Teachers Assessment (Sessional Work includes assignment, seminar, mini project etc.)

G. Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (L), Laboratory Instruction (P), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Draw curves of inter section of differed regular solids.

Session Out comes (SOs)	Laboratory Instruction(P)	Class room Instruction(L)	Self-Learning (SL)
SO1.1 Identify parts Where concept of intersection of the given solids is required. SO1.2 Explain the procedure to draw curves of intersection of surfaces of given regular solids.	LE1.1 Draw curves of intersection in case of cylinder with cylinder and cylinder with cone of given dimensions. LE1.2 Draw curves of intersection in case of cylinder with square Prism and Prism with Prism (Tri-angular and square) of given dimensions.	Unit-1.0 Intersection of Solids – Recall types of solids 1.1. Curves of intersection of surfaces of the regular solids in the following cases: 1.2. Prism with prism (Tri-angular and square), Cylinder with cylinder, Square Prism with Cylinder when i. The axes are at 90° and intersecting ii. The axes are at 90° and Offset 1.3. Cylinder with Cone: when axis of cylinder is parallel to both the reference planes and cone resting on base on HP and intersecting with the axis of cylinder.	● Cylinder with Cone: when axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis offset from axis of cylinder.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Draw curves of intersection of the surfaces of the cylinder with cylinder, when the axes are at other than 90° and intersecting each other (without offset).
- Draw curves of intersection of the surfaces of the cylinder with cone, when the axes are at other than 90°, with partially or fully intersecting.
- Draw intersection of Cylinder with Cone when axis of cylinder is parallel to both the Reference planes and cone resting on base on HP with axis off set from axis of cylinder in sketch book/drawing sheet.

b. Mini Project:



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i. Prepare models of card sheet for intersection of cylinder with cylinder and cylinder with cone

c. Other Activities(Specify):

i. Prepare a list of different industrial and domestic components where application of

Intersection of solids seen. (Group work with group size of five students each).

ii. Prepare a chart with photographs of domestic and industrial components where application of intersection of solid is seen. (Group work with group size of five students each).

CO-2: Draw the development of surfaces of various regular solids.

Session Outcomes(SOs)	Laboratory Instruction(P)	Class room Instruction(L)	Self-Learning (SL)
SO2.1 Identify parts Where concept of development of surfaces is required. SO2.2 Explain the Procedure to draw development of surfaces of given regular solids.	LE2.1 Draw development of surfaces of box, tray, funnel, chimney.	Unit-2.0 Development of surfaces 2.1 Development of Lateral surfaces of objects (box, cylinder, cone & pyramids) and their applications such as tray, funnel, Chimney.	Development of Prism and frustum of Prism.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Draw development of lateral surfaces of truncated Prism (rectangular cross sections).

ii. Draw development of lateral surface of frustum of cone.

iii. Draw development of a typical tray.

b. Micro Project:

i. Visit a tailoring shop and observe how body dimensions are used to create dresses. Correlate the same with development of surfaces and prepare a report.

ii. Based on one of the problems solved in drawing sheet, prepare a model using card sheet and validate different dimensions.

c. Other Activities(Specify):

i. Prepare a list of different industrial and domestic components where application of

Development of surfaces is seen.(group work with group size of five students each)

ii. Prepare a chart with photographs of domestic and industrial components where application of development of surface is seen. (Group work with group size of five students each).

CO-3 Use various drawing codes, conventions and symbols as per ISSP-46.

Session Out comes (SOs)	Laboratory Instruction (P)	Class room Instruction(L)	Self-Learning (SL)
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SO3.1 Use ISSP-46 (1988) codes for the given machine component or material. SO3.2 Interpret Standard conventions used in the given Mechanical working Drawing.	LE3.1 Draw symbols for representing different machine elements and materials.	Unit-3.0 Conventional Representations 3.1. Standard convention as per BIS[SP – 46 (1988)] 3.2. Materials-C.I., M.S, Brass, Bronze, Aluminum, wood, Glass, Concrete and Rubber 3.2. Long and short break in pipe, rod and shaft. 3.3. Ball and Roller Bearings. 3.4. Pipe joints, cocks, valves. 3.5. Internal/external threads, Knurling 3.6. Serrated shafts, splined shafts, and keys and key ways 3.7. Springs with square and flat ends 3.8. Gears, sprocket wheel, chain wheels 3.9. Counter sunk & counter bored holes 3.10. Tapers	Conventional representation of components specifically used in electrical/Civil fields.
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SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Draw conventional representation of common features like slotted head, radial rib, knurling, serrated shaft, splined shaft, ratchet and pinion, repeated parts, square on shafts, holes on circular pitch, internal and external thread.

b. Micro Project:

- Collect one Production drawing from an industry.
- Interpret different conventional representations and prepare a list of the same (group work with group size of five students each).

CO-4 : Use limits-fits-tolerances, surface finish and welding symbols and values in production drawings.

Session Outcome(SOs)	Laboratory Instruction (P)	Class room Instruction (L)	Self-Learning (SL)



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SO4.1 Interpret Different attributes of the given Production Drawing and Process Sheet of various components. SO4.2 Identify fits required between mating parts of machine components based on the given tolerance values. SO4.3 Use limits-fits-tolerance, surface finish and welding symbols in the given production drawing.	LE4.1 Draw limits-fits-tolerance, surface finish, and welding symbols in the given production drawing.	Unit-4.0 Limits-fits-tolerance, surface finish and welding symbols in Production drawing 4.1. Limits, fits and tolerances: Definitions, Introduction to ISO system of tolerances - unilateral and bilateral tolerance and its representation on drawing, dimensional tolerances, elements of interchangeable system, hole & shaft base systems, tolerance diagram, Selection of fit (clearance, transition and interference) for engineering applications. 4.2. Geometrical tolerances Definitions, Tolerances of form and position and its geometric representation-tolerance frame, datum feature, magnitude of tolerance and symbol, interpretation of a given symbol on drawing, simple examples. 4.3. General welding symbols, length and size of weld, surface contour and finish of weld, all round and site weld, symbolic representation in Engineering practices and its interpretation. 4.4. Characteristics of surface roughness Indication of machining symbol showing direction of lay, roughness grades, machining allowances, manufacturing methods, using ISO code. Relation of surface roughness values with Manufacturing processes.	● Interpret other machine symbols and information on a Production drawing
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SW-4 Suggested Sessional Work (SW):

a. Assignments:

- List out the types of tolerances used in machine drawing.
- Name the types of fits commonly used in production drawing and state their applications.

b. Micro Project:

- Collect one production drawing from an industry, interpret different limits-fits-tolerance, surface finish and welding symbols and prepare a list of the same (group work with group size of five students each).

c. Other Activities(Specify):

- Collect information related to fit between, piston cylinder, bearing shaft, late and shaper machine guide ways.

CO-5 Prepare exploded views from assembly drawing.

Session Out comes (SOs)	Laboratory Instruction (P)	Classroom Instruction (L)	Self-Learning (SL)



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SO5.1 Interpret details In the given Assembly.	LE5.1 Prepare exploded views of following assemblies:	Unit-5.0 Assembly to Detail drawing	- Bench vice & Pipe Vice. - Oldham & Universal couplings (Prepare exploded views of above assemblies)
SO5.2 State details and assembly sequence of components in the given assembly.	i.Flange coupling	5.1. Introduction, types of assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing. Bill of Material.	
SO5.3 Explain the procedure for creating assembly from the given components.	ii.Bushed Bearing	5.2. Exploded view of :	
	iii.Plummer Block	i.Flange coupling	
	iv.Lathe Square Tool Post	ii.Plummer Block	
	v. . Knuckle Joint	iii.Lathe Square Tool Post	
	vi. Cast Iron Pulley	iv.Knuckle Joint	
	vii. Any other Assembly consisting of 6- 10 parts.	v. Cast Iron Pulley	
		vi. Any other assembly consisting of 6 -10 parts.	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Prepare exploded views of Screw jack.
- Prepare exploded views of Lathe machine square tool post

b. Micro Project:

- Collect five sample production drawing of a same component compare them and.

c. Other Activities(Specify):

- Collect 5 samples of scrap springs of different sizes and types individually and fix them collectively on a single board with labels.

CO-6 Prepare assembly drawings from exploded views of machine component

Session Out comes (SOs)	Laboratory Instruction(P)	Classroom Instruction(L)	Self-Learning (SL)



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SO6.1 Identify various components in the given assembly and the sequence of dismantling it. SO6.2 Explain procedure to prepare detailed drawing from the given assembly drawing.	LE6.1 Prepare assembly drawing from given exploded views.	Unit-6.0 Details to Assembly 6.1 Introduction, types of assembly drawing, accepted norms to be observed for assembly drawings, sequence for preparing assembly drawing, Bill of Material. i. Flange coupling ii. Plummer Block iii. Lathe Square Tool Post iv. Knuckle Joint v. Cast Iron Pulley	• Assembly drawing of stuffing box
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SW-6 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare assembly drawing of piston, eccentric.

b. Mini Project: Prepare assembly from given exploded views of following manually:

i. Flange coupling

ii. Plummer Block

CO-7 Draw isometric and orthographic sectional views of simple machine elements manually and using computer aided drafting software.

Session Outcomes (SOs)	Laboratory Instruction (P)	Class room Instruction (L)	Self-Learning (SL)
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SO7.1 Explain the procedure of drawing isometric and orthographic view(s) of given simple machine elements manually. SO7.2 Explain the Procedure of drawing Isometric and orthographic view(s) of given simple machine elements using computer aided drafting software.	LE7.1 Draw isometric and Orthographic sectional views of simple machine elements (any four) manually. LE7.2 Draw isometric and Orthographic sectional views of simple machine elements (any four) using computer Aided drafting software.	Unit-7.0 Isometric and Orthographic Sectional views 7.1. Recall Isometric and orthographic projections. 7.2. Conversion of pictorial view into Orthographic views and Conversion of orthographic views into isometric View/projection. 7.3. Need for sectional views, Cutting plane and line, Sectioning conventions and section lines. 7.4. Types of sections: Full, Half, Broken, Removed, Revolved and Offset 7.5. Recall Draw, Modify, Edit and Plot commands. 7.6. Isometric and Orthogonal drawings using any computer aided drafting software (AutoCAD).	Auxiliary views.
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SW-7 Suggested Sessional Work (SW):

a. Assignments:

i. Prepare a list of popularly used Draw, Modify, Edit and Plot commands of AutoCAD software.

b. Micro Project:

i. Draw the sectional views of at least 3 mechanical assemblies mentioned in from Unit 5.0 above using AutoCAD software.

Note: Performance under Laboratory and Sessional work may appear in more than one COs/SOs.

H) Suggested Specification Table (For ESE of Classroom Instruction):

Unit Number	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
I	Inter section of Solids	-	2	10	12
II	Development of surfaces	-	2	10	12
III	Conventional Representations	4	-	6	10
IV	Limits-fits-tolerance, surface finish and welding Symbols in Production drawing	4	-	6	10



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V	Assembly to Detail drawing	-	-	20	20
VI	Assembly to Details	-	-	20	20
VII	Isometric and Orthographic Sectional views	2	4	10	16
Total		10	8	82	100

Legend: R: Remember, U: Understand, A: Apply and above

I) Suggested Specification Table(For ESE of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Titles	Assessment of Laboratory Work (Marks)			Marks are allocated for performance under ESE based on following performance
		Performance		Viva-Voce	
		PRA	PDA		

LE1.1	Draw curves of intersection in case of cylinder with cylinder and cylinder with Cone of given dimensions.	15	10	5	parameters: • Submission of drawings as per schedule • Neatness, Cleanliness on all prepared drawing sheets • Uniformity in drawing and line work • Dimensioning the given drawing and writing text • Visualization and drawing ability
LE1.2	Draw curves of intersection in case of cylinder with square Prism and Prism with Prism(Tri-angular and square) of given dimensions	15	10	5	
LE2.1	Draw development of surfaces of funnel, Chimney and pipe bend.	15	10	5	
LE3.1	Draw symbols for representing different machine elements and materials.	15	10	5	
LE4.1	Draw limits-fits-tolerance, surface finish, and welding symbols in the given Production drawing.	15	10	5	



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LE5. 1	Prepare exploded views of following assemblies: i.Flange coupling ii.Bushed Bearing iii.Plummer Block iv.Lathe Square v.Tool Post vi.Knuckle Joint vii.Cast Iron Pulley Any other assembly consisting of 6-10 parts.	15	10	5	
LE6. 1	Prepare assembly drawing from given Exploded views.	15	10	5	
LE7. 1	Draw isometric and Orthographic sectional views of simple machine elements (any four) manually.	15	10	5	● Use of appropriate institute templates and commands ● Answer to viva-voce questions
LE7. 2	Draw isometric and Orthographic sectional views of simple machine elements (any four) using computer aided drafting software.	15	10	5	

*Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments / practicals.

Legend: PRA: Process Assessment, PDA: Product Assessment

Note:

Only one experiment has to be performed at the end semester examination of **30Marks** as per assessment scheme

J) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits
6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Facebook, Mobile)



12. Brain storming

13. Others

K) Suggested Learning Resources:**a. Books:**

S. No.	Titles	Author	Publisher	Edition*
1	Machine Drawing	R.K.Dhawan	S.Chand and Company	New Delhi, ISBN:81-219-1431-0
2	Fundamentals of Machine Drawing	Sadhu Singh, P. L. Sah	PHI	Latest
3	Machine Drawing Including AutoCad	Ajeet Singh	TMH	Latest
4	Machine Drawing	Bhatt N.D., Panchal V.M.	Charotar Publishing House Pvt.Ltd., Anand, Gujarat,	2013, ISBN 9789380358635
5	Engineering Drawing practice for schools and colleges IS:SP-46	Bureau of Indian standard	BIS Delhi	Third reprint, October 1998 ISBN 8170610912
6	Production Drawing	Narayanan L.K., Kannaich P., Venkat Reddy K.	New Age International Publication, New Delhi	2009, ISBN: 9788122435016
7	Engineering Drawing	Bhatt N.D.	Charotar Publishing house Pvt. Ltd. Anand, Gujarat,	ISBN:9789380358178
8	A text book of Machine Drawing	Gill P.S.	S.K.Kataria and Sons, New Delhi	2007, ISBN: 9789350144169
9	Machine Drawing	N. Sidheswar, P. Kannaiah, V.V.S. Sastry	Mc Graw Hill, New Delhi	2009, ISBN: 9780074603376
10.	Machine Drawing and Computer Aided Drafting	Aparajita Banerjee	Neelkanth Publishers	ISBN: 9788184445947
11.	Machine Drawing and Computer Aided Drafting	Dr. Sumitra Sharma	Manju Publications	ISBN: 9788119220021



*Latest edition of all above books should be referred

b. Open source software and website address:

1. user.engineering.uiowa.edu/~mie032/support/eg/eg07_section_views.pdf
2. web.aeromech.usyd.edu.au/.../Engineering%20Drawings%20Lecture%20Sectioning
3. <https://knowledge.autodesk.com/support/autocad/learn-explore>
4. nptel.ac.in/courses/112103019/35
5. <https://www.youtube.com/watch?v=1ABIR5ePOLQ>
6. ebooks.bharathuniv.ac.in/.../Assembly%20Drawing%20of%20Production%20Drawin
7. www.me.metu.edu.tr/courses/me114/Lectures/assembly.htm
7. app.ute.edu.ec/content/3255.../Machine%20Drawing%20-%20Narayana%20K.pdf

8. https://engineering.pages.tcnj.edu/files/2012/02/dimensioning_and_tolerancing.pdf
9. nptel.ac.in/syllabus/112106075/
10. nptel.ac.in/courses/112103019/33
11. <https://www.youtube.com/watch?v=5APldtR-xx4>
12. <https://www.slideshare.net/vagallasuresh/unit-7-interpenetrations-of-solids>
13. sketchup7softwareforsolidmodelling
14. <http://www.weldingtechnology.org>
15. <http://www.newagepublishers.com>
16. [EngineeringgraphicsandDrawingv1.0fromcognifront](https://www.youtube.com/watch?v=01YPja2wCYQ)
17. <http://www.youtube.com/watch?v=01YPja2wCYQ>
18. <http://www.youtube.com/watch?v=9AGD4tihjCg&feature=plcp>
19. <http://www.youtube.com/watch?v=n65NU32inOU>
20. <http://www.youtube.com/watch?v=tyRVsSsNiUQ>
21. http://www.youtube.com/watch?v=_M5eYB6056M
22. <http://www.youtube.com/watch?v=UyROI-bAMu4>
23. <http://www.youtube.com/watch?v=eix8xbqb93s>
24. <http://www.youtube.com/watch?v=kWOI6ttDTBc>
25. <http://www.youtube.com/watch?v=gJbrO2jtoa8&feature=related>
26. <http://www.youtube.com/watch?v=PXgkBadGHEE>
27. [EngineeringGraphics&Drawingv1.0fromCognifront](https://www.youtube.com/watch?v=UyROI-bAMu4)
28. <http://npkauto.com/assignments>

c. Others:

1. Learning Packages
2. Users' Guide
3. Manufacturers' Manual
4. Lab Manuals

L) List of Major Laboratory Equipment and Tools:

S.No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Computer aided drafting Software like AutoCAD	Latest educational licensed Network version	LE7.1,LE7.2
2	CAD workstations	latest configuration	LE7.1,LE7.2
3	Drawing boards	A1 size	All



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4	Interactive board (165 x 130 cm)	Supports dual touch, dual write and intuitive gestures, such as toss, rotate and zoom, available with multi touch operating systems, such as Windows®	All
5	Sample production/construction drawings	From nearby industries, construction companies and developed by senior teachers of The state	LE1.1,LE1.2,LE2.1,LE3.1, LE4.1,LE5.1,LE6.1,LE7.1, LE7.2
6	Printer/plotter	A3size	LE7.1,LE7.2
7	Models for projection and demonstration	Wooden models	All



M) Mapping of POs and PSOs with COs:

Course Outcomes(COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2	PSO-3
CO-1 Draw curves of inter section of different regular solids.	2	3	3	2	1	1	1	2	2	2	-	2	1
CO-2 Draw the development of surfaces of various regular solids.	2	3	2	2	1	1	1	2	2	2	-	2	1



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CO-3 Use various drawing codes, convention and symbols as per IS SP-46.	1	3	2	2	1	1	3	2	2	2	-	2	1
CO-4 Use limits-fits-tolerances, surface finish and welding symbols and values in production drawings.	2	3	2	2	1	1	3	2	2	2	-	2	1
CO-5 Prepare exploded views from assembly drawing of machine component.	1	3	2	2	1	1	1	2	2	2	-	2	1
CO-6 Prepare assembly drawings from exploded views of machine component.	1	3	2	2	1	1	1	2	2	2	-	2	1



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CO-7 Draw isometric and orthographic sectional views of simple machine elements manually and using computer aided drafting software.	1	3	2	3	1	1	2	2	3	2	1
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Legend: 1–Low, 2–Medium, 3–High

**N) Course Curriculum Map:**

POs & PSOs No.	Cos No. & Titles	SOs No.	Laboratory Instruction (P)	Classroom Instruction (L)	Self-Learning (SL)
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-2,3	CO-1 Draw curves of intersection of different regular solids.	SO1.1 SO1.2	LE1.1 LE1.2	Unit1.0 Intersection of Solids 1.1,1.2,1.3	As mentioned in relevant page numbers.
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-1,2,3	CO-2 Draw the development of surfaces of various regular solids.	SO2.1 SO2.2	LE2.1	Unit2.0 Development of surfaces 2.1	
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-2,3	CO-3 Use various drawing codes, conventions and symbols as per IS SP-46.	SO3.1 SO3.2	LE3.1	Unit3.0 Conventional Representations 3.1, 3.2, 3.3,3.4, 3.5, 3.6, 3.7, 3.8, 3.9,3.10,3.11	
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-1,2,3	CO-4 Use limits-fits-tolerances, surface finish and welding symbols and values in production drawings.	SO4.1 SO4.2 SO4.3	LE4.1	Unit4.0 Limits-fits-tolerance, surface finish and welding symbols in Production drawing 4.1,4.2,4.3,4.4	
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-2,3	CO-5 Prepare exploded views from assembly drawing of machine component.	SO5.1 SO5.2 SO5.3	LE5.1	Unit5.0 Assembly to Detail drawing 5.1,5.2	
PO-1,2,3,4, 5,6, 7,8,9,10 PSO-2,3	CO-6 Prepare assembly drawings from exploded views of machine component.	SO6.1 SO6.2	LE6.1	Unit6.0 Assembly to Details 6.1, 6.2, 6.3, 6.4, 6.5, 6.6	



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PO-1,2,3,4,5,6,7,8,9,10 PSO-1,2,3	CO-7 Draw isometric and orthographic sectional views of simple machine elements manually and using Computer aided drafting software.	SO7.1 SO7.2	LE7.1	Unit7.0 Isometric and Orthographic Sectional views 7.1,7.2,7.3,7.4,7.5,7.6	
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- A) Course Code : 2037C05CT037
B) Course Title : Manufacturing Technology



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C) Pre- requisite Course Code and Title : None

D) Rationale :

Manufacturing is a core area in the field of mechanical engineering. The basic knowledge of different manufacturing processes is essential to select the most appropriate process for getting the desired results in terms of converting the raw material to finished product as per the requirements. This course on Manufacturing Process aims at providing knowledge and skills regarding different types of manufacturing processes and use machines, equipment and tools safely. It also develops understanding to suggest and manipulate vital process parameters related to different manufacturing processes as well as the behavior of metal and change in it during different manufacturing process.

E) Course Outcomes:

CO-1 Recall concepts of working and construction lathe and drilling machine.

CO-2 Prepare product using different casting processes.

CO-3 Prepare product using different forming processes.

CO-4 Use joining process to produce jobs

CO-5 Produce jobs using plastic molding process.

F) Scheme of Studies and Assessment:

Board of Studies (BOS)	Course (Subject)	Course Code	Period per Week			Scheme of Examination			Total Marks	Credits	Teaching Hour	Assessment Hour
			L	T	P	Theory/Lab						
						ESE	CT	TA				
Mechanical	Manufacturing Technology	2037C05CT037	2	1	-	100	20	20	140	3	45	15
	Manufacturing Technology(Lab)	2037C04CL037	-	-	2	40	-	20	60	1	15	15

Legend: L: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others) , P : Laboratory Instruction (Includes Practical performances in laboratory/ workshop, field or other locations using different instructional strategies) , ESE: End Semester Examination, CT: Class Test, TA: Teachers Assessment (Sessional Work includes assignment, seminar, mini project etc.)

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

H) Course-Curriculum Detailing:

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.



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CO-1 Recall concepts of working and construction lathe and drilling machine.

(Approx. Hrs:

L+P+T=8)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g (SL)



SO1.1 Explain various components of lathe machine. SO1.2 Describe job and tool holding devices. SO1.3 Calculate speed, feed, depth of cut of lathe machine. SO1.4 Perform simple lathe operations. SO1.5 Perform Drilling, reaming and boring operation.	LE1.1 Prepare one simple turning job as per given drawing. LE1.2 Perform step turning, threading operation to prepare job as per given drawing. LE1.3 Perform drilling, reaming and boring operation on pillar drill machine as per given drawing. LE 1.4 Perform plain milling operation on a milling machine as per the given drawing. LE 1.5 Perform side milling operation on a milling machine as per given drawing. LE 1.6 Perform indexing operation as per the given drawing.	Unit 1. Lathe, Drilling and Milling Machine 1.1 Recall Concept, Working principle, constructional details and major components of lathe machine with their functions. 1.2 Job and tool holding devices and lathe attachment – head stock, tail stock, tool post, Lathe tools, chucks (3 and 4 Jaw), name and advantages of lathe attachment. 1.3 Lathe operations – Facing, Plain turning, taper turning, step turning, knurling, threading etc. 1.4 Drilling machine- classification, specification, constructional features. 1.5 Drilling machine operations- Drilling, reaming, boring, counter sinking, counter boring. 1.6 Milling Machine: Working principle, types of milling machines. 1.7 Milling cutters: Different types of cutters, face milling cutters end milling cutters, staggered tooth milling cutter, side and face milling cutter, form milling cutters and metal slitting saw. 1.8 Milling Process: Plain milling, face milling, side milling, end milling, straddle milling, gang milling, up and down milling. 1.9 Dividing head: Types, function of dividing head, method of indexing. 1.10 Cutting Parameters – Cutting speed, feed, depth of cut.	SL1.1
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SW-1 Suggested Sessional Work (SW):



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- a. **Assignments:**
 - i. Discuss the advantages and limitations of metal-removal processes of manufacturing. .
- b. **Mini Project:**
 - i. Surf WWW and collect five videos related to manufacturing of different domestic and industrial components. (Individual student assignment)
- c. **Other Activities (Specify):** Collect Information of manufacturing industries in your city.

CO-2 Prepare product using different casting processes.

(Approx. Hrs:

L+P+T=18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)



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SO2.1 Select pattern allowances for a given application.	LE2.1 Prepare a pattern drawing, pattern and core for a given component or component drawing.	Unit 2.0 Metal Casting 2.1 Definition and Need 2.2 Pattern: types, materials, pattern allowances, color code, applications 2.3 Cores: Need, types, materials 2.4 Moulds: Molding sand: Types, properties, binders, additives, mixing, Molding equipment & tools Type of moulds, mould making, applications 2.5 Melting of metal: Pit furnace, Cupola, Induction furnace. 2.6 Metal pouring: Gates and Risers. 2.7 Casting Processes: Dry sand mould casting, Shell mould casting, Investment casting, Die casting, Centrifugal casting. 2.8 Casting defects: Blow, scar, blister, gas holes, pin holes, porosity, drop, inclusion, dross, dirt, wash, buckle, scab, rat tail, penetration, swell, misrun, cold shut, hot tear, shrinkage cavity, mould shift, core shift and 2.9 Inspection of castings: Visual inspection, magnetic particle inspection, dye penetration inspection, Radiographic inspection, ultrasonic inspection. 2.10 Safety precautions in metal casting.	SL2.1 Slush casting, Permanent mold or Gravity die casting
SO2.2 Interpret the color coding on pattern and core.	LE2.2 Prepare a sand mould using a given single piece pattern.		
SO2.3 Select relevant type of mould for a given application.	LE2.3 Prepare a sand mould using a given split pattern.		
SO2.4 Select suitable furnace for a given application.	LE2.4 Prepare casting using the mould made in 2.2 and wax in place of molten metal.		
SO2.5 Explain the importance of gates and risers.			
SO2.6 Select appropriate casting process for a given application.			
SO2.7 Identify casting defects and explain their causes.			
SO2.8 Select a suitable inspection method for identifying given defects in a casting.			

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Identify the factors affecting the selection of pattern material for a given application.
- Compare and prepare a chart showing the applications of various types of patterns.
- Identify the need of core prints.
- Sketch the gating system for pouring metal in a casting.
- Explain the effect of grain size and shape of molding sand.
- Explain the causes and remedies of common casting defects.



b. **Micro Project:** Visit a nearby foundry and prepare a report comprising of details (type, material, process, etc) of items produced, quantities, consumables and equipment used with specification, process parameters being used.

c. **Other Activities (Specify):**

- i Prepare a chart to show the different tools used for making patterns.
- ii Compare and prepare a chart showing the advantages, disadvantages and applications of different casting methods.
- iii Prepare a chart showing the various casting defects and ways to prevent them.
- iv Prepare a chart showing the methods for identifying various casting defects.

CO-3 Prepare product using different forming processes.

(Approx. Hrs: L+P+T= 18)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Explain Cold and Hot working processes and their effects on metal properties. SO3.2 Select relevant forming process for a given application or component.	LE3.1 Prepare aluminum washer using flywheel press. LE3.2 Prepare two jobs using hot forging.	Unit 3.0 Metal Forming and Press working 3.1 Cold and hot working of metals, effect on metal properties, advantages & limitations. 3.2 Forming processes, types, working principle, tools and equipment, applications of: Rolling, Forging, Drawing, Deep drawing, Extrusion. 3.3 Defects in rolling, forging process. 3.4 Press working: Emphasis that press working is not forming process, Punching, Blanking, Notching, Lancing, Slitting, Nibbling, Trimming.	SL3.1 Wire drawing

SW-3 Suggested Sessional Work (SW) :



a. Assignments:

- Explain the importance of recrystallization temperature in mechanical working of metals.
- Prepare a list of methods used for production of pipes and tubes.
- Compare the cold working and hot working of metals.
- Prepare a chart showing the different sheet metal operations.

b. Micro Project: Visit a nearby Rolling mill/allied manufacturing processes industry and prepare a report comprising of details(type, material, process, etc) of items produced, quantities, different sections, equipments used with specification, process parameters being used.

c. Other activity –

- Collect information on various extrusion machines.
- Collect information on various forging machine

CO-4 Use joining process to produce jobs.

(Approx. Hrs: L+P+T= 16)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Explain different welding processes. SO4.2 Suggest appropriate welding process for a given application. SO4.3 Identify weld defects and their causes. SO4.4 Practice safe practices during joining processes.	LE4.1 Prepare a lap joint using spot welding equipment. LE4.2 Use seam welding to join two sheets of metal. LE4.3 Prepare a V – Butt joint using TIG welding. LE4.4 Use MIG welding to join given metal pipe.	Unit 4.0Metal Joining 4.1 Classification, gas and arc welding processes. 4.2 Working principle, equipment, sketch, process parameters, applications of: (i) MIG, TIG, Flux coated arc and submerged arc (ii) Resistance welding – Butt, Seam, Spot, Projection and Percussion. (iii) Thermit welding. (iv) Forged welding 4.3 Effects of welding heat 4.4 Weld defects and their causes. 4.5 Automation and Recent trends in Welding technology – Robotic Welding, CNC welding	SL 4.1 Laser welding, Electron beam welding, Friction welding, Explosive welding

SW-4 Suggested Sessional Work (SW) :

a. Assignments:



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- List the advantages, disadvantages and applications of welding over other joining processes.
- Compare the merits, demerits and applications of MIG and TIG.
- Distinguish thermit welding from ordinary arc welding.
- Compare spot and seam welding.

b. Micro Project: Visit a nearby fabrication industry and prepare a report comprises of types of item produced, quantities, different sections, equipments used with specification and consumables.

c. Other Activities (Specify):

- Prepare a chart showing the detailed classification of welding process.
- Collect information on various welding machine.

CO-5 Produce jobs using plastic molding process.

(Approx.

Hrs:L+P+T=14)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Suggest appropriate plastic molding method for a given application/component. SO5.2 Explain the concept of powder metallurgy and its applications.	LE5.1 Prepare a given job using blow molding process. LE5.2 Prepare a job using injection molding process.	Unit 5.0 Plastic Molding and Powder Metallurgy 5.1 Plastic Molding: Concept, working principle, equipment and applications of Compression molding, Blow molding, Injection molding and Extrusion. 5.2 Powder Metallurgy: Introduction, advantages and disadvantages, Powder metallurgy processes: Powder making, blending, compacting, sintering, infiltration and impregnation, Applications	● Application of blow molding

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI : Laboratory Instruction (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning

SW-5 Suggested Sessional Work (SW) :

a. Assignments:

- List the applications of different plastic molding processes.
- Identify and explain the main stages of powder metallurgy process.
- Write down the applications of powder metallurgy process.



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iv. Compare the powder metallurgy process with other manufacturing processes.

b. Micro Project: Visit a nearby plastic industry and prepare a report comprising of types of item produced, quantities, consumables and equipment used with specification and consumables.

c. Other Activities (Specify):

i. Visit a nearby plastic industry and prepare a report comprising of type of item produced and capacity

I) Suggested Specification Table (For ESA of Classroom Instruction CI+SW+SL):

Unit Number	Unit Title	Marks Distribution			Total Marks
		R	U	A	
I	Lathe, Drilling and Milling Machine	4	9	12	25
II	Metal Casting	2	6	12	20
III	Metal Forming and Press Working	2	6	12	20
IV	Metal Joining	2	6	12	20
V	Plastic Molding and Powder Metallurgy	2	4	9	15
Total		10	24	66	100

Legend: R: Remember, U: Understand, A: Apply and above

J) Suggested Specification Table (For ESA of Laboratory Instruction*):

Laboratory Instruction Number	Short Laboratory Experiment Title	Assessment of Laboratory Work (Marks)		
		Performance		Viva-Voce
		PRA	PDA	
LE1.1	Prepare one simple turning job as per given drawing.	20	15	5
LE1.2	Perform step turning, threading operation to prepare job as per given drawing.	20	15	5
LE1.3	Perform drilling, reaming and boring operation on pillar drill machine as per drawing.	20	15	5
LE 1.4	Perform plain milling operation on a milling	20	15	5



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	machine as per the given drawing.			
LE 1.5	Perform side milling operation on a milling machine as per the given drawing.	20	15	5
LE 1.6	LE 1.5 Perform side milling operation on a milling machine as per given drawing.	20	15	5
LE2.1	Prepare a pattern drawing, pattern and core for a given component or component drawing.	20	15	5
LE2.2	Prepare a sand mould using a given single piece pattern.	20	15	5
LE2.3	Prepare a sand mould using a given split piece pattern.	20	15	5
LE2.4	Prepare casting using the mould made in LE2.2 and wax in place of molten metal.	20	15	5
LE3.1	Prepare aluminum washer using flywheel press.	20	15	5
LE3.2	Prepare two jobs using hot forging.	20	15	5
LE4.1	Prepare a lap joint using spot welding equipment.	20	15	5
LE 4.2	Use seam welding to join two sheets of metal.	20	15	5
LE 4.3	Prepare a V – Butt joint using TIG welding.	20	15	5
LE 4.4	Use MIG welding to join given metal pipe.	20	15	5
LE5.1	Prepare a given job using blow molding process.	20	15	5
LE5.2	Prepare a job using injection molding process.	20	15	5

*Assessment rubric, process and product check list with rating scale need to be prepared by the course wise teachers for each experiment for conduction and assessment of laboratory experiments /practicals ,

Legend: PRA: Process Assessment, PDA : Product Assessment

K) Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Industrial visits



6. Industrial Training
7. Field Trips
8. Portfolio Based Learning
9. Role Play
10. Demonstration
11. ICT Based Teaching Learning (Video Demonstration, CBT, Blog, Face book, Mobile)
12. Brainstorming
13. Others

L) Suggested Learning Resources:

(a) Books :

. No.	Title	Author	Publisher and Edition*
1	Material Science and Metallurgy	P. Khanna	Dhanpat Rai Publishing Company Private Limited, New Delhi ISBN 13: 9789383182459
2	Manufacturing Science	Amitabha Ghosh and Asok Kumar Malik	Affiliated East West Press Pvt Ltd. ISBN 13: 9780745800592
3	Manufacturing Technology	R. K. Rajput	CBS, 2 edition, 2006, ISBN-10: 8123908946 ISBN-13: 978-8123908946
4	Manufacturing Process	O. P. Khanna	Dhanpat Rai Publishing Company Private Limited, New Delhi ISBN: 9788189928230, 8189928236
5	Introduction to Basic Manufacturing Processes and Workshop Technology	Rajender Singh	New Age International ISBN (13) : 978-81-224-2316-7
6	Production Technology	R. K. Jain	Khanna Publishers ISBN 10: 8174090991 ISBN 13: 9788174090997
7	Production Technology	P. C. Sharma	S. Chand Publishing ISBN : 9788121911146 N
8	Basic Manufacturing Processes, Theory & Practice	R. C. S. Mehta, N. S. Gaira	Viva Books Pvt. Ltd. ISBN: 9789386243928,



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9	Elements of Workshop Technology Vol. I	Hajra Choudhury	Media Promoters and Publishers Pvt Ltd. ISBN 090621601X, 9780906216019
10	Workshop Technology Vol. I	B. S. Raghuwanshi	Dhanpat Rai and Sons ISBN-13: 5551234001924.
11	Manufacturing Technology Vol. I & II	P. N. Rao	McGraw Hill· ISBN: 9781259062575 (Vol. 1) ISBN:9789332901018 (Vol 2)
12	Workshop Technology Vol. I	H. S. Bawa	Tata McGraw Hill ISBN (13): 9780074600269
13	निर्माण प्रक्रम MANUFACTURING PROCESS - HINDI	P N Vijayavergiya	DEEPAK PRAKASHAN ISBN (13):9788177762563
14	मेनुफेक्चरिंग प्रोसेस इंजीनियरिंग तथा प्रैक्टिस MANUFACTURING PROCESS ENGINEERING & PRACTICE	Aniket Modi	DEEPAK PRAKASHAN ISBN (13):9788194137504

*Latest edition of all above books should be referred

(b) Open source software and website address:

- (1) Manufacturing process NPTEL Courses- <http://nptel.ac.in/courses/112107145/>
- (2) Casting methods -https://www.youtube.com/results?search_query=basic+of+casting+process
- (3) Casting defects- https://www.youtube.com/results?search_query=casting+deffects+
- (4) Moulding methods- https://www.youtube.com/results?search_query=moulding+methods
- (5) Hot working - https://www.youtube.com/results?search_query=hot+working+methods
- (6) Extrusion Process- <https://www.youtube.com/watch?v=Y75IQksBb0M>
- (7) Rolling process - https://www.youtube.com/results?search_query=rolling+process
- (8) Metal spinning- https://www.youtube.com/results?search_query=metal+spinning
- (9) Wire drawing- https://www.youtube.com/results?search_query=wire+drawin
- (10) Forging methods- https://www.youtube.com/results?search_query=forging+methods
- (11) Welding process - https://www.youtube.com/results?search_query=welding+process
- (12) Effects of heat treatment processes on material properties-
https://www.youtube.com/results?search_query=Effects+of+heat+treatment+processes+on+material+p+roperties

(c) Others:

1. Learning Packages
2. Users' Guide
3. Manufacturers' Manual
4. Lab Manuals

M) List of Major Laboratory Equipment and Tools:



S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Foundry tools and equipments – hand riddle, shovel, Hand, peen & floor rammer, sprue pin, strike off bar, mallet, draw spike, vent rod, lifters, trowels, slicks, smoothers, swab, spirit level, gate cutter, gaggers, nails and wire pieces, clamps, cotters and wedges, Molding box, crucible etc.	As per requirement	LE2.1 to LE2.4
2	Flywheel Press/Hydraulic Press	1 - 5 ton capacity suitable for small products like washers etc.	LE3.1
3	Hot Forging equipment	Standard hot forging press suitable for forging small parts complete with all tools and accessories.	LE3.2
4	Spot welding machine	15 KVA, Input voltage 330 – 440 Volt, Air cooled transformer	LE4.1
5	Seam welding machine	75 KVA, Weld head: Cylinder dia 100 mm, stroke 100 mm,	LE4.2
6	MIG welding machine	Standard MIG welding machine for welding of low carbon steel, stainless steel, aluminium etc.	LE4.4
7	TIG welding machine	3 phase, 230-415 Volt	LE4.3
8	Blow molding machine	Hydraulically/pneumatically operated Standard machine, product size 30-50 ml, mould cavity – 2	LE5.1
9	Injection molding machine	Electrically operated standard machine suitable for small products like bottle caps, combs, buckets etc.	LE5.2
10	Milling Machine	As per requirement	LE 1.4, 1.5, 1.6



N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PSO-1	PSO-2	PSO-3
CO-1	0	2	2	3	2	1	1	3	2	2	0	1	0
CO-2	2	2	2	3	2	1	1	3	2	2	0	1	1
CO-3	2	2	2	3	2	1	1	3	2	2	0	1	1
CO-4	2	2	2	3	2	1	1	3	2	3	0	1	1
CO-5	2	2	2	3	2	1	1	3	2	3	0	1	1

Legend:3: High, 2: Moderate, 1: Low and 0: No correlation

N) Mapping of POs & PSOs with COs:

Course Outcomes (COs)	Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)	
	PO-1 Basic knowledge	PO-2 Discipline knowledge	PO-3 Experiments and practice	PO-4 Engineering Tools	PO-5 The engineer and society	PO-6 Environment and sustainability	PO-7 Ethics	PO-8 Individual and team work	PO-9 Communication	PO-10 Life-long learning	PSO-1	PSO-2



Semester-III

CO 1	Recall concepts of working and construction of lathe drilling and milling machine.	✓	✓	-	-	-	-	-	✓	✓	✓	✓	✓			
CO-1	Prepare product using different casting processes.	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓			
CO-2	Prepare product using different forming processes.	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓			
CO-3	Use joining process to produce jobs	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓			
CO-4	Produce jobs using plastic molding process.	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓			

Legend: 1 – Low, 2 – Medium, 3 – High

O) Course Curriculum Map:

POs & PSO No.	COs No.& Title	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)



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As above	CO 1 Recall concepts of working and construction lathe and drilling machine.	SO1.1 SO1.2 SO1.3	LE1.1 LE1.2	Unit-1.0 Lathe Machine and Drilling machine 1.1, 1.2, 1.3	SL1.1
As above	CO 2 Prepare product using different casting processes.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6 SO2.7 SO2.8	LE2.1 LE2.2 LE2.3	Unit-2.0 Metal Casting 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9	SL2.1
As above	CO 3 Prepare product using different forming processes.	SO3.1 SO3.2	LE3.1 LE3.2	Unit-3.0 Metal Forming and Press working 3.1, 3.2, 3.3, 3.4	SL3.1
As above	CO 4 Use joining process to produce jobs	SO4.1 SO4.2 SO4.3 SO4.4	LE4.1 LE4.2 LE4.3 LE4.4	Unit-4.0 Metal Joining 4.1, 4.2, 4.3, 4.4	SL4.1
As above	CO 5 Produce jobs using plastic molding process.	SO5.1 SO5.2	LE5.1 LE5.2	Unit-5.0 Plastic Molding and Powder Metallurgy 5.1, 5.2, 5.3, 5.4	

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others) , LI : Laboratory Instruction n (Includes Practical performances in Laboratory, Workshop, field or other locations using different instructional strategies) SL: Self Learning



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- A) **Course Code** : 2037C05FL022
 B) **Course Title** : Idea and Innovation Lab
 C) **Pre- requisite Course Code and Title** :

D) **Rationale** :

The Idea and Innovation Lab provides hands-on, experiential learning component in the Diploma Engineering program to nurture skills. The course aims to instill an innovation mindset among students by guiding them through the complete cycle of problem identification, idea generation, conceptual design, prototyping, testing, and pitching. It emphasizes design thinking, teamwork, and user-centric development, encouraging students to step beyond textbooks and apply their knowledge to practical, meaningful challenges.

E) **Course Outcome:**

CO1: Develop creative thinking, innovation skills, and problem-solving mindset.

CO2: Learn the process of taking an idea from concept to working prototype

CO3: Apply design thinking in real-world scenarios

CO4: Understand and evaluate prototype

CO5: Prepare technical report and demonstrate awareness of IPR

F) **Scheme of Studies:**

Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)				
			L	P	T	Total Study Hours (L+T+P)	Total Credits(C) (L+T+P/2)
Computer Science and Engineering	2037C05FL022	Idea and Innovation Lab	0	2	0	2	1

Legend: Lecture (L), Tutorial (T) and Practical(P)

G) **Scheme of Assessment:**

Board of Study	Course Code	Course Title	Scheme of examination					
			Total Marks					Total Marks
			Theory			Practical		
			ES E	CT	TA	ESE	TA	
Computer Science and Engineering	2037C05FL022	Idea and Innovation Lab	0	0	0	0	30	30

H) **Course-Curriculum Detailing:**

This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Laboratory Instruction (LI) and Self Learning (SL). Students are expected to demonstrate the attainment of Session Outcomes (SOs) and finally Course Outcomes (COs) upon the completion of course.

CO-1 Develop creative thinking, innovation skills, and problem-solving mindset



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(Approx. Hrs: LI +SL =5)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Self-Learning (SL)
SO1.1 List of real-world problems SO1.2 Shortlisted idea proposals	Unit-1.0 Ideation & Problem Identification 1.1. Introduction to Innovation & Design Thinking 1.2. Empathizing with users and identifying real-life problems 1.3. Brainstorming, Mind Mapping, SCAMPER method 1.4. Creating clear problem statements	1.1 Different creative thinking techniques. 1.2 List of Real life problems

CO-2 Learn the process of taking an idea from concept to working prototype.

(Approx. Hrs: LI+ SL =6)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Self-Learning (SL)
SO2.1 Concept document SO2.2 Wireframes, flow diagrams	Unit-2.0 Concept Development 2.1 Concept sketching, use-case creation 2.2 Wireframes, user journey mapping 2.3 Technical feasibility study 2.4 Functional requirement gathering	2.1. Basic blueprint making 2.2. Feasibility study

CO-3 Apply design thinking in real-world scenarios

(Approx. Hrs: LI+ SL =7)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Self-Learning (SL)
SO3.1 Selection of tools and technologies SO3.2 Prototype plan	Unit-3.0 Tools & Technologies for Prototyping 3.1 Web/Mobile app prototyping tools (like Figma, HTML/CSS basics) 3.2 Basics of hardware/software integration 3.3 Component selection, system design	3.1 Usage of different tools. 3.2 Hardware Software integration

CO-4 Understand and evaluate prototype

(Approx. Hrs: CI+LI+SW+SL =7)



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Session Outcomes (SOs)	Laboratory Instruction (LI)	Self-Learning (SL)
SO4.1 Working prototype (Minimum Viable Product)	Unit-4.0 Building the Prototype 4.1 Development of the Prototype 4.2 Interface design, module integration 4.3 Testing and Evaluation 4.4 Final refinement of prototype based on feedback	4.1 Prototype models 4.2 Interface design 4.3 Prototype evaluation methods 4.4 Debugging steps

CO-5 Prepare technical report and demonstrate awareness of IPR

(Approx. Hrs: LI+ SL

=5)

Session Outcomes (SOs)	Laboratory Instruction (LI)	Self-Learning (SL)
SO5.1 Students will be able to prepare technical reports SO5.2 Students will be able to demonstrate prototypes SO5.3 Students will be able to understand IP basics.	Unit5. Reporting and IPR 5.1. Reporting of results/ demos: process of explaining the project idea, working and results. 5.2. Learning intellectual property basics: legal rights given to creations of the mind. Types of Intellectual Property i. Patent –Protects new inventions ii. Copyright – Protects written work, software iii. Trademark –Protects logos, brand names iv. Design Rights – Protects product appearance its Importance for Students	Identify the purpose of Form 1 and Form 2 in the patent application process. List the difference between Provisional Specification and a Complete specification while filing an IPR List the specific features as per Design act that constitutes a Design

D) Suggested Learning Resources:

S. No.	Titles	Author	Publisher	Edition & Year
1	Developing Thinking Skills (The way to Success)	E Balaguruswamy	Khanna Publication, 2022	1 st Edition 2022
2	Product Design and Manufacturing	A.K. Chitale and R.C. Gupta	Prentice Hall, India	7 th edition
3	Ideas to Innovation: Creativity, Design Thinking, IPR & the Innovation Ecosystem	Dr Gaurav Kumar	Atlantic Publishers and Distributors (P) Ltd.	1 st edition, 2025
4	Startupology: Ideation to Execution for First-Time Founders	Vivek Chadha	Zebra Learn	1 st edition, 2025



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5	8 Steps to Innovation	Vinay Dabholkar, Rishiksha T Krishnan	Collins	1 st edition, 2013
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J) List of Suggestive Laboratory Equipment and Tools:

1.	Simulation Software	Necessary Licensed softwares with Desk top Computer with minimum processor of 3 GHz, 64 bit, Graphic Card, 16 GB RAM and SSD drive.
2.	3 D Printer	Print Technology Fused Deposition modelling, Material Supported PLA, ABS, PETG and flexible TPU, Build volume: Suitable for prototype and projects (200mmx200mmx200mm) to (300mmx300mmx300mm), Layer resolution 50-300 micron, Software: Open-source software compatibility e.g., Cura, Prusa Slicer that can import standard CAD formats like STL or OBJ
3.	Development Boards & Sensors	Example: Arduino UNO, Arduino MEGA, Arduino 8266, ESP 32 etc, RTC Module, Temperature sensors, Light sensors, Motion sensors, Pressure sensors, Humidity Sensors, Gas sensors
4.	Display Boards	Character LCDs, Graphic LCDs, OLED and TFT LCDs
5.	Tools & Measuring Instruments	Drilling Machines, Automated welding machines, CNC lathes, Soldering stations, Digital Multimeters, Waveform analyzers,



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- A) Course Code : 2037C06ET046
- B) Course Title : Indian Traditional Knowledge: Science and Practice
- C) Pre- requisite Course Code and Title : None
- D) Rationale :

E) Course Objectives:

1. Creating awareness amongst the youths about the true history and rich culture of the country;
2. Understanding the scientific value of the traditional knowledge of Bhārata;
3. To familiarize learners with major sequential development in Indian science, engineering and technology.
4. To review & strengthen the ancient discovery and research in physics, chemistry, maths, metallurgy, astronomy, architecture, textile, transport, agriculture and Ayurveda etc.
5. To understand the importance of functional, aesthetic, psychological, culture and socio religious concepts of ancient India architecture.

F) Course Outcomes:

1. Students understand the various traditional practices of ancient India.
2. They have been introduced to some concepts of Ancient Indian Physics and Chemistry.
3. They have been introduced to some concepts of Ancient Indian Science (Metallurgy, Astronomy & Astrology).
4. They have been introduced to some fields of IKS like Ancient Architecture and Engineering.

G) Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)				
			L	P	T	Total Study Hours (L+T+P)	Total Credits(C) (L+T+P/2)
Humanities	2037C06ET046	Indian Traditional Knowledge: Science and Practices	1	0	0	1	1

Legend: Lecture (L), Tutorial (T) and Practical(P)

H) Scheme of Assessment:

Board of Study	Course Code	Course Title	Scheme of examination					
			Total Marks					Total Marks
			Theory			Practical		
			ES E	CT	TA	ESE	TA	



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Humanities	2037C06ET046	Indian Traditional Knowledge: Science and Practices	0	0	20	0	0	20
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UNIT I: Bhāratīya Civilization and Development of Knowledge System

(4

Hours)

Genesis of the land, Antiquity of civilization, On the Trail of the Lost River, Discovery of the Saraswatī River, the Saraswatī-Sindhu Civilization, Traditional Knowledge System, Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Vedic Life: A Distinctive Features, Ancient Education System, the Takṣaśilā University, the Nālandā University, Knowledge Export from Bhārata.

UNIT II: ANCIENT INDIAN SCIENCE

(4 Hours)

Physics in India: Vaisheshika darshan Atomic theory & law of motion, theory of panchmahabhoota, Brihath Shathaka (divisions of the time, unit of distance), bhaskaracharya (Theory of gravity, surya siddhanta & sidhanta shriomani), Lilavati (gurutvakashan Shakti).

Chemistry in India: Vatsyayana, Nagarjuna, Khanda, Al-Biruni, Vagbhaṭa –building of the ras-shala (laboratory), working arrangements of ras-shala, material and equipment, Yaśodhara Bhaṭṭa-process of distillation, apparatus, saranasamskara, saranataila

UNIT III: ANCIENT INDIAN TECHNOLOGY

(4 Hours)

Metallurgy in India: Engineering Science and Technology in the Vedic Age and Post-Vedic Records, Mining and ore extraction, Survarṇa (gold), Rajata (silver), Tamra (copper), Loha (iron), Vanga (tin), Naga / sisa (lead), Pittala (brass), and steel in ancient India, Apparatuses used for extraction of metallic components, Iron Pillar of Delhi.

Astronomy and Astrology: The Beginnings of Indian Astronomy - The Early Historical Period-The Siddhāntic Era., Ancient Indian Observational astronomy. Foundation concepts - nakṣatra, graha, time units, phenomena like meteors, eclipses., Brief notes on Astronomical instruments like sundials, water clock, time measurement. Aryabhatta - Varahamihira- Bhaskara I – Brahamagupta- Bhaskara II

UNIT IV: ARCHITECTURE AND CIVIL ENGINEERING (3 Hours)



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Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture, Eight limbs of Vāstu, Town planning, Temple architecture in India, Iconography, Architecture in India: Nagara (northern style), Vesara (mixed style), and Dravida (southern style), Indian vernacular architecture, Temple style, cave architecture, rock cut architecture, kalinga architecture, chandels architecture, rajput architecture, jain architecture, sikh architecture, Maratha architecture.

Text Books: (Hindi and English language as per availability)

1. Textbook on “The Knowledge System of Bhārata by Bhag Chand Chauhan.
2. वास्तविक आईना सनातन विज्ञान का, परम कुमार, वैभव प्रकाशन रायपुर
3. SCIENTIFIC BASIS OF INDIAN KNOWLEDGE SYSTEM Saroj Sharma, Bal Krishna Rai, Sunita Joshi Kathuria, SHIPRA PUBLICATIONS
4. R P Kulkarni, Glimpse of Indian Engineering and Technology (Ancient & Medieval period, Munshiram Manoharlal Publishers Pvt. Ltd. 2018.
5. Sen, S. N., and Shukla, K. S. (Ed.) (2000). History of Astronomy in India, 2nd Revised Edition. New Delhi: Indian National Science Academy.
6. D N Shukla Civil Architecture in Ancient India (Part-I) Meharchand lakshmidas publication, 2016.

Reference Books: (Hindi and English language both)

1. Iyengar, R. N. (2016) Astronomy in Vedic texts, History of Indian Astronomy, A Handbook - Volume brought out on the occasion of IX International Conference on Oriental Astronomy November 14–18.
2. Pride of India- A Glimpse of India’s Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati (2006).
3. Vedic Physics by Keshav Dev Verma, Motilal Banarsidass Publishers (2012).
3. India’s Glorious Scientific Tradition by Suresh Soni, Ocean Books Pvt. Ltd. (2010).
4. AK Pathak, Science and Technology in India, Anshika prakashan pratapgarh, 2016.
5. AR vasudev Murty, Science and Technology in Ancient India as Reflected in the Mahabharata, Sanskrit bharati, 2019.
6. B Dagens, Mayamata: An Indian Treatise on Housing Architecture and Iconography (An Updated Edition with revised Glossary), Motilal banrsidas, 2017.
7. Dr. V. Ganapati Sthapati, Building Architecture of Sthapatya Veda.

A)	Course Code	: 2037C07DT046
B)	Course Title	: Personality Development



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C) Pre- requisite Course Code and Title : None

Course Objectives: This course aims to develop self-awareness, self-management, communication, interpersonal, and professional skills in students to enhance their personality and prepare them for career and workplace readiness.

D) Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of Studies (Hours/Week)				
			L	P	T	Total Study Hours (L+T+P)	Total Credits(C) (L+T+P/2)
Humanities	2037C7DT046	Personality Development	1	0	0	1	0

Legend: Lecture (L), Tutorial (T) and Practical(P)

E) Scheme of Assessment:

Board of Study	Course Code	Course Title	Scheme of examination					
			Total Marks					
			Theory			Practical		Total Marks
			ES E	CT	TA	ESE	TA	
Humanities	2037C7DT046	Personality Development	0	0	10	0	0	10

Course Contents:

Unit I: Personality & Self-Awareness – Concept and determinants of personality, Self-awareness and SWOT analysis, Attitude and confidence building.

Unit II: Self-Management– Stress management techniques, Time management and goal setting, Body language.

Unit III: Interpersonal Skills – Interpersonal transactions and Transactional Analysis (TA) basics; Conflict – Types and resolution, Digital communication etiquette: email writing, netiquette, and professional social media presence.

Unit IV: Teamwork – Group dynamics and team building, Leadership skills, Collaboration and coordination, Problem-solving in teams.

Unit V: Professional Skills – Public speaking and presentation skills: overcoming stage fear, structuring a talk, use of visuals; Workplace etiquette: professional appearance, meeting conduct, and workplace relationship.

Course Outcomes:

CO No.	Course Outcome	Bloom's Level
CO1	Identify personality traits and perform self-assessment analysis.	Remember (L1) / Understand (L2)
CO2	Apply self-management techniques for personal and career goals.	Apply (L3)
CO3	Demonstrate effective interpersonal skills in various contexts.	Apply (L3)



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CO4	Analyze group dynamics and exhibit teamwork abilities.	Analyze (L4)
CO5	Develop professional competencies and workplace etiquettes.	Create (L6)

Text Books:

S.No.	Title	Authors	Edition	Publisher
1	Personality Development and Soft Skills	Barun K. Mitra	-	Oxford University Press
2	Communication Skills and Personality Development	J.R. Kadam et al.	-	Scientific Publishers

Reference Books:

S.No.	Title	Authors	Edition	Publisher
1	Communication Skills and Personality Development	M. Jegadeesan et al.	-	-
3	How to Win Friends and Influence People	Dale Carnegie	-	-