Curriculum of Diploma Programme

in

Mechanical Engineering

Department of Science,
Technology and Technical Education (DSTTE),
Govt. of Bihar

State Board of Technical Education
(SBTE), Bihar

Semester – III
Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	Teaching & Learning Scheme(Hours/Week)					
			Classroom Instruction(CI)		Lab Instruction (LI)	Notional Hours (TW+SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2425301	**PCC**	**Manufacturing Engineering**	03	-	04	02	09	06
2425302	**PCC**	**Material Science & Engineering**	02	01	-	02	05	04
2425303	**PCC**	**Strength of Materials for Mechanical Engg.** (ME, Me (Auto))	03	-	04	02	09	06
2425304	**PCC**	**Basic Thermodynamics** (ME, ME (Auto))	02	01	04	02	09	06
2425305	**PCC**	**Computer Aided Drafting and Modeling** (ME, ME (Auto))	-	-	04	02	06	03
2425306	**PSI**	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	02	02	04	02
2400207	**NRC**	**Indian Constitution** (Common for All Programmes)	01	-	-	-	01	01
2400108	**NRC**	**Essence of Indian Knowledge System and Tradition** (Common for All Programmes)	01	-	-	-	01	01
2400110	**NRC**	**Community/ Society Development** (AIML, AE, CSE, ELX (R), CHE, EE, ME, ME (Auto), MIE, FTS, CACDDM, FPP)	01	-	-	-	01	01
Total			**13**	**2**	**18**	**12**	**45**	**30**

Note: Prefix will be added to course code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. todeliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, work shop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - III
Assessment Scheme

Course Codes	Category of course	Course Titles	Assessment Scheme (Marks)						
			Theory Assessment (TA)		Term work &Self Learning Assessment (TWA)		Lab Assessment (LA)		Total Marks (TA+TWA+LA)
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2425301	**PCC**	**Manufacturing Engineering**	30	70	20	30	20	30	200
2425302	**PCC**	**Material Science & Engineering**	30	70	20	30	-	-	150
2425303	**PCC**	**Strength of Materials for Mechanical Engg.** (ME, Me (Auto))	30	70	20	30	20	30	200
2425304	**PCC**	**Basic Thermodynamics** (ME, ME (Auto))	30	70	20	30	20	30	200
2425305	**PCC**	**Computer Aided Drafting andModeling** (ME, ME (Auto))	-	-	20	30	20	30	100
2425306	**PSI**	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	10	15	10	15	50
2400207	**NRC**	**Indian Constitution** (Common for All Programmes)	25	-	25	-	-	-	50
2400108	**NRC**	**Essence of Indian Knowledge System and Tradition** (Common for All Programmes)	25	-	-	-	-	-	25
2400110	**NRC**	**Community/ Society Development** (AIML, AE, CSE, ELX (R), CHE, EE, ME, ME (Auto), MIE, FTS, CACDDM, FPP)	25	-	-	-	-	-	25
Total			**195**	**280**	**135**	**165**	**90**	**135**	**1000**

Note: Prefix will be added to course code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will becarried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubics for these activities.

A) Course Code **: 2425301 (T2425301/P2425301/S2425301)**

B) Course Title **:** Manufacturing Engineering

C) Pre- requisite Course(s) **:** Mechanical Workshop Practice, Mechanical Properties of Materials

D) Rationale **:**

Through manufacturing processes, the raw material is converted into a finished product. Knowledge of basic manufacturing processes such as Casting, Forming, Welding, and Machining is essential for students to perform duties in manufacturing industries/units. The basic knowledge of different manufacturing processes is essential to select the most appropriate process and related parameters for getting the desired results in terms of converting the raw material to finished product as per the requirements. This course on manufacturing engineering aims at providing knowledge regarding different types of manufacturing processes and use of related machines, equipment and tools safely. The knowledge gained through this course will also help the students to take up advanced and manufacturing related courses in the next semesters.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

- **CO-1.** Select suitable manufacturing process to produce various components.
- **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.** Machine jobs using machine tools like Lathe, Drilling, Milling, Shaping, Slotting etc.
- **CO-6.** Perform estimation and costing related calculations for components produced from mentioned four manufacturing processes.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	2	-	2	-	1	1		
CO-2	3	2	-	2	-	1	1		
CO-3	3	2	-	2	-	1	1		
CO-4	3	2	-	2	-	1	1		
CO-5	3	2	-	2	-	1	1		
CO-6	3	2	-	-	-	3	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

J) Theory Session Outcomes (TSOs) and Units: T2425301

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number(s)
TSO 1a. Classify manufacturing processes. *TSO 1b.* Explain the given basic conventional manufacturing process. *TSO 1c.* Describe the given mechanical property. *TSO 1d.* Select suitable conventional manufacturing process for the given application with justification.	**Unit-1.0 Introduction to Manufacturing Processes** 1.1 Classification of basic manufacturing process based on Formative, Subtractive and Additive manufacturing processes; Chip-less and Chip-removal processes, Primary and Secondary manufacturing processes; Generating & Forming processes; Conventional and Non-Conventional Manufacturing Processes 1.2 Factors which influence selection of manufacturing process for a particular application. 1.3 Recall mechanical properties of metals.	CO1
TSO 2a. Explain the given casting process. *TSO 2b.* Select pattern and allowances for the given application with justification. *TSO 2c.* Interpret the color coding on pattern and core. *TSO 2d.* Explain the given property(ies) of moulding sand. *TSO 2e.* Explain the method of green sand mould preparation. *TSO 2f.* Explain the moulding method and working of the given moulding machine. *TSO 2g.* Explain the use of the given core. *TSO 2h.* Select suitable furnace for the given application with justification. *TSO 2i.* Explain the importance of gates and risers. *TSO 2j.* Find out pouring, solidification time and size of riser. *TSO 2k.* Select appropriate casting process for the given application with justification. *TSO 2l.* Identify casting defects and explain their causes. *TSO 2m.* Select a suitable inspection method for identifying given defects in the given casting with justification. *TSO 2n.* Perform estimation and costing related calculations for the given product to be cast by the given casting method.	**Unit-2.0 Casting Processes** 2.1 Introduction to casting, advantages, and disadvantages of casting. 2.2 Pattern, types of patterns, pattern materials, pattern allowance, colour code 2.3 Moulding sand constituents and its types, properties of moulding sand, moulding sand preparation, moulding tools and moulding boxes, types of moulds-green sand mould, dry sand mould, loam sand mould 2.4 Methods of moulding, Moulding machines; Jolting – Squeezing – Sand slinger, Construction and working principle. 2.5 Cores: Essential qualities of core materials, core sand preparation, core binder, core boxes, co2 process of core making, types of cores 2.6 Melting furnace; Blast furnace, Cupola furnace, Crucible furnace, Pit Furnace, Induction Furnace. 2.7 Casting processes: Green sand Casting, Permanent mould casting, Shell mould casting, Investment casting, Centrifugal casting, 2.8 Gating system, types of gating system, design of riser 2.9 Defects in casting: causes and remedies. 2.10 Inspection of castings: Visual inspection, pressure test, magnetic particle inspection, dye penetration inspection, Radiographic inspection, ultrasonic inspection. 2.11 Safety precautions in metal casting. 2.12 Estimation and costing of casting components.	CO2, CO6
TSO 3a. Explain metal forming and nature of plastic deformation. *TSO 3b.* Explain Cold and Hot working processes and their effects on metal properties.	**Unit-3.0 Metal Forming Processes** 3.1 Introduction, nature of plastic deformation. 3.2 Bulk and Sheet metal forming processes.	CO3, CO6

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number(s)
TSO 3c. Differentiate Bulk and Sheet metal forming processes. *TSO 3d.* Explain the given Bulk forming process. *TSO 3e.* Calculate major parameters related to the given Bulk forming process (Drop forging, Rolling, Extrusion, Drawing). *TSO 3f.* Select relevant Bulk forming process for the given application or component with justification. *TSO 3g.* Explain the given Sheet metal forming process. *TSO 3h.* Calculate main parameters related to the given Sheet metal forming process (Punching-Blanking, Deep Drawing, and Bending). *TSO 3i.* Select relevant Sheet metal forming process for the given application or component with justification. *TSO 3j.* Perform estimation and costing related calculations for the given product to be formed using bulk and sheet metal forming method.	3.3 Hot working, cold working – advantages and disadvantages of hot working and cold working. 3.4 Bulk metal forming processes: Rolling, Forging (Smith forging, Drop forging, Upset forging), Extrusion, Drawing. 3.5 Press Working: Types of presses – mechanical and hydraulic presses – press tools and accessories, press working operations. 3.6 Sheet metal forming processes (Press tools operations): Shearing, Blanking-Punching, Embossing-Coining, Piercing, Trimming, Shaving, Nibbling, Notching, Lancing, Deep drawing, Spinning, Bending, Stretch forming, 3.7 Estimation and costing of metal forming components.	
TSO 4a. Classify different joining processes. *TSO 4b.* Explain the given Oxy-acetylene welding flame(s). *TSO 4c.* Describe Oxy-acetylene welding, related equipment and material. *TSO 4d.* Describe the given Arc welding process (Manual metal arc welding, Inert-gas shielded arc welding- TIG and MIG, Submerged arc-welding), related equipment and materials. *TSO 4e.* Explain the process of resistant welding (Spot and Seam), related equipment and materials. *TSO 4f.* Explain the process and application of Thermit welding, Friction welding, Explosion welding, Brazing, and Soldering. *TSO 4g.* Suggest appropriate welding process for the given application with justification. *TSO 4h.* Identify weld defects and their causes. *TSO 4i.* List safe practices during welding processes. *TSO 4j.* Perform estimation and costing related calculations for the given product to be welded using different welding processes.	**Unit-4.0 Joining Processes** 4.1 Introduction to Joining Processes: Permamnet and Temporary; Welging, Soldering, Brazing, Adhesive bonding. 4.2 Classification of welding processes, types of welded joints. 4.3 Gas welding: Oxy-acetylene welding, types of flame, Oxy-acetylene welding equipment, filler rod, Gas cutting. 4.4 Arc welding: Principle of arc creation, Arc welding equipment, electrodes, arc blow, Types of Arc welding process. Working principle, equipment, process parameters, applications of: Manual metal arc welding (flux coated electrodes), Inert-gas shielded arc welding, Tungsten inert-gas welding (TIG), Metal inert-gas arc welding (MIG), Submerged arc-welding, Plasma arc welding. 4.5 Resistance welding – Butt, Seam, Spot, Projection and Percussion. 4.6 Other welding processes: Thermit welding, Friction welding, Explosion welding, Forged welding, Friction Welding. 4.7 Brazing, soldering and Adhesive bonding. 4.8 Effects of welding heat-Heat affected zone 4.9 Weld defects and their causes. 4.10 Safety precautions in welding. 4.11 Estimation and costing of welded components	CO4, CO6
TSO 5a. Explain chip formation and types of chips. *TSO 5b.* Explain mechanics of orthogonal metal cutting. *TSO 5c.* Explain cutting tool geometry and tool nomenclature. *TSO 5d.* Explain tool materials and tool wear.	**Unit-5.0 Machining and Machine Tools** Machining: 5.1 Introduction to metal cutting. 5.2 Chip formation and types of chips. 5.3 Mechanics of orthogonal metal cutting 5.4 Cutting tool material and geometry	CO5, CO6

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number(s)
TSO 5e. Estimate tool life for the given values of speed fee and DoC. *TSO 5f.* Select suitable cutting fluid for the given situation. *TSO 5g.* Explain the method of application of the given cutting fluid. *TSO 5h.* Explain the operation of the given lathe machine. *TSO 5i.* Explain the function of the given Lathe machine part(s). *TSO 5j.* Explain the given Milling machine operation and the tool used. *TSO 5k.* Explain the function of the given Milling machine part(s). *TSO 5l.* Describe the given hole making operation(s) (drilling, reaming, boring, tapping). *TSO 5m.* Explain the working of the given Shaping/ Planing/Slotting machine. *TSO 5n.* Explain use of jigs and fixtures. *TSO 5o.* Calculate Speed, Feed, DoC in the given operation to be performed on Lathe/Milling/Drilling/Shaping machine. *TSO 5p.* Calculate machining time required to produce the given part using Lathe, Milling, Drilling and Shaping machine(s). *TSO 5q.* Perform estimation and costing related calculations for the given product to be machined using different machine tools.	5.5 Tool wear and tool life. 5.6 Cutting fluids, types of cutting fluids, selection of cutting fluid, method of application of cutting fluids Machine tools: 5.7 Lathe machine: introduction to lathe machine, types of lathe machine, basic parts and function, basic operations and tools. 5.8 Milling machine: introduction to milling machine, types of milling machine, basic parts and function, basic operations and tools 5.9 Hole making operation: drilling, reaming, boring, tapping. 5.10 Introduction and application of shaper, planer, slotting machine. 5.11 Introduction and application of jigs and fixtures 5.12 Estimation and costing of machining components.	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425301

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO 1.1. Identify type of pattern *LSO 1.2.* Calculate pattern allowances as per the given requirement and material. *LSO 1.3.* Prepare pattern using all the required allowances as per the given drawing.	1.	Prepare a single piece pattern considering the shrinkage allowances, draft allowance, machining allowances and shake allowances	CO2
LSO 2.1. Identify the ingredients of green sand moulding. *LSO 2.2.* Identify different types of patterns. *LSO 2.3.* Use moulding boxes and other tools to create green sand mould. *LSO 2.4.* Prepare green sand mould using the given pattern. *LSO 2.5.* Withdraw pattern from the sand. *LSO 2.6.* Provide provisions for Gating system, Runner and Riser in the sand mould.	2.	Prepare a green sand mould using the following patterns: • Single piece pattern, • Multi piece pattern, • Match plate pattern, • Gated pattern, • Sweep pattern, • Loose piece pattern,	CO2
LSO 3.1. Interpret the drawing of the component.	3.	Produce a simple part using green sand casting and single piece pattern as per the given component drawing.	CO2

LSO 3.2. Prepare sound green sand mould with gating system and riser. *LSO 3.3.* Use furnace to melt the metal at pouring temperature. *LSO 3.4.* Pour the molten metal with safety and in minimum time inside the mould cavity. *LSO 3.5.* Monitoring solidification of casting and remove the casted part from the mould without damaging the part. *LSO 3.6.* Cleaning the casted part.			
LSO 4.1. Select the recrystalisation temperature for the given metal. *LSO 4.2.* Select appropriate hot/cold forming process and related parameters. *LSO 4.3.* Produce part using the selected hot/cold forming process.	4.	Produce a simple job using any cold/hot working forming process.	CO3
LSO 5.1. Select appropriate die and punch combination. *LSO 5.2.* Select process parameters. *LSO 5.3.* Hold the sheet properly in the press tool. *LSO 5.4.* Produce the part using the required sheet metal forming process.	5.	Prepare a simple job like washer etc. using any sheet metal forming process (press tool operations)	CO3
LSO 6.1. Arrange the oxy-accetylene welding setup. *LSO 6.2.* Set the welding process parameters. *LSO 6.3.* Develop appropriate flame type as per metal. *LSO 6.4.* Set the sheets in Lap/Butt/T positions. *LSO 6.5.* Perform welding *LSO 6.6.* Follow safety practices.	6.	Prepare the following joints using Oxy-acetylene gas welding process. • Lap joint, • Butt joint • T joint	CO4
LSO 7.1. Arrange the Arc welding setup. *LSO 7.2.* Fix the proper flux coated electrode in the holder. *LSO 7.3.* Set the welding process parameters. *LSO 7.4.* Maintain proper acr for welding. *LSO 7.5.* Set the plates in Lap/Butt/T positions. *LSO 7.6.* Perform welding *LSO 7.7.* Follow safety practices.	7.	Prepare the following joints using Manual Arc welding process. • Lap joint, • Butt joint • T joint	CO4
LSO 8.1. Arrange the TIG/MIG welding setup. *LSO 8.2.* Set the TIG/MIG welding process parameters. *LSO 8.3.* Set the plates/pipes in Lap/Butt/T positions. *LSO 8.4.* Perform welding *LSO 8.5.* Follow safety practices.	8.	Prepare the following joints using TIG/MIG welding process. • Lap joint, • Butt joint • T joint	CO4
LSO 9.1 Arrange the SS welding setup. LSO 9.2 Set the SS welding process parameters. LSO 9.3 Set the SS rods/pipes in Lap/Butt/T positions. LSO 9.4 Perform SS welding LSO 9.5 Follow safety practices.	9.	Prepare a Balcony grill using welding of Stainless Steel (SS) pipes.	CO4
LSO 10.1. Arrange the Spot-welding setup. *LSO 10.2.* Set the Spot-welding process parameters. *LSO 10.3.* Set the plates in spot welding machine. *LSO 10.4.* Perform Spot welding *LSO 10.5.* Follow safety practices.	10.	Perform Spot welding operation.	CO4

LSO 11.1. Arrange the Gas cutting setup. *LSO 11.2.* Set the Gas cutting process parameters and flame. *LSO 11.3.* Set the plates for cutting as per drawing. *LSO 11.4.* Perform Gas cutting *LSO 11.5.* Follow safety practices.	11.	Perform gas cutting operation on a sheet as per the given drawing.	CO4
LSO 12.1. Arrange Solder/Braze and Soldering/Brazing tool. *LSO 12.2.* Choose and set appropriate temperature for Soldering/Brazing. *LSO 12.3.* Apply flux. *LSO 12.4.* Set the parts/crack for Soldering/Brazing. *LSO 12.5.* Perform Soldering/Brazing. *LSO 12.6.* Follow safety practices.	12.	Make a joint using Soldering/Brazing.	CO4
LSO 13.1. Identify all the 6 tool angles and nose radius. *LSO 13.2.* Use Tool Makers microscope *LSO 13.3.* Grind all 6 angles as per given values.	13.	Grind the angles on a single point cutting tool as per drawing using tool makers microscope and grinder.	CO5
LSO 14.1. Interpret the drawing *LSO 14.2.* Setup the Lathe for the given operation. *LSO 14.3.* Choose the correct work holding device. *LSO 14.4.* Choose suitable tools for the given Lathe operation. *LSO 14.5.* Perform centering of the job. *LSO 14.6.* Set machining process parameters for the given lathe operation. *LSO 14.7.* Perform the given Lathe operation (Facing, Step Turning, Taper turning, Chamfering, Groove Cutting, Knurling, Thread Cutting). *LSO 14.8.* Follow safety practices.	14.	Produce parts on Lathe machine with following operations as per the given drawing: • Facing, Step Turning, Taper turning and Chamfering • Groove Cutting & Knurling • Thread Cutting	CO5
LSO 15.1. Interpret the drawing *LSO 15.2.* Setup the Milling machine for the given operation. *LSO 15.3.* Choose the correct work holding device. *LSO 15.4.* Choose suitable cutter for the given Milling operation. *LSO 15.5.* Set machining process parameters for the given Milling operation. *LSO 15.6.* Perform the given Milling operation (Pocket cutting, Groove cutting). *LSO 15.7.* Follow safety practices.	15.	Produce parts on Milling machine with following operations as per the given drawing: • Pocket cutting • Groove Cutting	CO5
LSO 16.1. Interpret the drawing *LSO 16.2.* Setup the Drilling/Boring machine for the given operation. *LSO 16.3.* Choose the correct work holding device. *LSO 16.4.* Choose suitable bit/reamer/tap for the given Hole related operation. *LSO 16.5.* Set process parameters for the given Hole operation. *LSO 16.6.* Perform the given hole operation (Hole making, Boring, Reaming, Tapping). *LSO 16.7.* Follow safety practices.	16.	Perform following hole making, finishing and threading operations as per the given drawing: • Hole making • Boring • Reaming • Tapping	CO5

LSO 17.1. Interpret the drawing *LSO 17.2.* Setup the Shaper for the given operation. *LSO 17.3.* Choose the correct work holding device. *LSO 17.4.* Choose suitable tools for the given Shaper operation. *LSO 17.5.* Perform the positioning of the selected tool in the Shaper tool post. *LSO 17.6.* Set machining process parameters for the given Shaper operation. *LSO 17.7.* Perform the given Shaper operation (Key way cutting, Dove tail groove cutting). *LSO 17.8.* Follow safety practices.		Perform following operations on Shaping machine per the given drawing: • Key way cutting • Dove tail groove cutting	CO5

L) Suggested Term Work and Self Learning: S2425301 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

- Discuss the advantages and limitations of chip-less and chip-removal processes of manufacturing.
- Prepare the list of domestic and industrial applications of various generating and forming processes of manufacturing.
- List out at least 10 applications of chip-less processes of manufacturing.
- 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 causes and remedies of common casting defects.
- Explain different casting processes.
- Solve numerical problems on forming parameters related to Bulk and Sheet metal forming processes.
- Compare the cold working and hot working of metals.
- Explain the importance of recrystallisation temperature in mechanical working of metals.
- Prepare a list of methods used for production of pipes and tubes.
- Prepare a chart showing the different sheet metal operations.
- Explain different Bulk and Sheet metal forming processes.
- Solve simple numerical problems on forming parameters related to Bulk and Sheet metal forming processes.
- 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 Manual arc welding.
- Compare spot and seam welding.
- Explain different Welding processes.
- Solve simple numerical problems on welding parameters related to different welding processes.
- Explain the effect of various tool angles on metal cutting.
- Prepare a list of commonly used cutting fluid and lubricants in given conditions.

A) Course Code **: 2425302 (T2425302/S2425302)**

B) Course Title **:** Material Science and Engineering

C) Pre- requisite Course(s) **:** Basic knowledge about metal and non-metal

D) Rationale **:**

Material Science and Engineering is the basic understanding about the internal body structures, defects, properties etc of the ferrous and non-ferrous materials. So, knowledge of their properties and composition is essential. This subject deals with the solidification of metal and alloy, equilibrium diagrams and their application. It covers metrological aspects of metal and alloy such as micro and macroscopic examination of metal and alloy. The subject includes study of iron- iron carbon equilibrium diagrams, TTT diagram, various heat treatment processes. It discusses about failure analysis, different types of destructive testing, corrosion of materials.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO1- Correlate between the internal structure of materials and their properties
CO2- Interpret equilibrium phase diagrams
CO3- Select relevant Non-Ferrous metal & Anti friction alloy material for the given application
CO4- Use destructive and nondestructive testing method to test the properties of material.
CO5- Select relevant material for the given application.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	1	-	-	-		
CO-2	3	2	1	-	-	-	1		
CO-3	3	1	-	-	-	-	1		
CO-4	3	2	1	1	1	-	1		
CO-5	3	1	-	-	-	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

J) Theory Session Outcomes (TSOs) and Units: T2425302

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
TSO.1a Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc *TSO.1b* Explain various types of bonds with their applications *TSO.1c* Choose the suitable crystalline material for given application. *TSO.1d* Identify the defects in given crystalline materials *TSO.1e* Solve the given problems	**Unit-1.0 Introduction to Engineering Material** 1.1 Classification of materials: metals, ceramics, polymers and composites, Engineering requirements of materials, relevant properties (physical, mechanical, thermal, electrical, chemical), cost; Range of applications; Material designation and standards; Ashby diagrams; Selection criteria and process 1.2 Nature of bonding in materials: metallic, ionic, covalent and mixed bonding; structure of materials: fundamentals of crystallography, symmetry operations, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions; structures of metals, ceramics, polymers, amorphous materials and glasses. 1.3 Defects in crystalline materials- 0-D, 1-D and 2-D defects; vacancies, interstitials, solid solutions in metals and ceramics, Frenkel and Schottky defects-dislocations, grain boundaries, twins, stacking faults; surfaces and interfaces.	**CO1**
TSO 2a. Describe major types of special steels such as HSLA, TRIP, Dual and Tool steels and cast-irons *TSO 2b.* Analyze the phase diagrams to identify the phases present in different alloy systems *TSO 2c.* Explain the structure and properties of given ferrous metals and alloys *TSO 2d.* Select relevant ferrous metal for specific applications. *TSO 2e.* Describe Standard commercial grades of steel as per BIS and AISI *TSO 2f.* Describe the basic terminologies associated with identification of phase diagrams and reactions *TSO 2g.* Solve the given problems	**Unit-2.0 Ferrous Metal & Phase Diagram** 2.1 Ferrous metals and its Alloys, Iron ores – Pig iron: classification, composition and effects of impurities on iron; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wrought Iron; comparison of cast iron, wrought iron and mild steel and high carbon steel 2.2 Alloy Steels – purpose of alloying; effects of alloying elements – Important alloy steels: Silicon steel, High Speed Steel (HSS), heat resisting steel, spring steel, Stainless Steel (SS): types of SS, applications of SS – magnet steel – composition, properties and uses 2.3 Standard commercial grades of steel as per BIS and AISI 2.4 Phase diagrams- Gibbs phase rule, Degrees of Freedom, Unary phase diagram, Introduction to Binary phase diagram- Isomorphous system, Eutectic system, Eutectoid system, Iron-Carbon binary diagram, flow sheet for production of iron and steel, Application of phase diagram	**CO2**
TSO.3a Explain the structure and properties of given nonferrous metals and alloys *TSO.3b* Select relevant non-ferrous metal and anti-friction alloy for specific applications *TSO.3c* Correlate the properties of given material with its composition.	**Unit-3.0 Non-Ferrous metal & Anti Friction Alloy** 3.1 Non-ferrous metals and its Alloys – Properties and uses of aluminum, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminum alloys: Duralumin, hindalium, magnalium -composition, properties and uses; Nickel alloys: Inconel, monel, nichrome – composition, properties and uses 3.2 Anti-friction/Bearing alloys: Various types of bearing bronzes – Standard commercial grades as per BIS/ASME.	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
TSO.4a Describe the various factors affecting/causing failures *TSO.4b* Select material for the given problem that can with stand catastrophic failures at different environment. *TSO.4c* Interpret the relationship between stress and strain *TSO.4d* Analyze the yielding behavior and dislocation influence on plastic deformation *TSO.4e* Determine properties of given material using different testing methods. *TSO.4f* Apply corrosion preventive techniques on the given material *TSO.4g* Describe corrosion prevention procedure for the given material. *TSO.4h* Describe coating and surface treatment procedure for the given material. *TSO.4i* Describe various methods to quantify the mechanical integrity of materials and their failure criteria *TSO.4j* Solve the given problems	**Unit-4.0 Destructive Testing and Nondestructive Testing** 4.1 Failure analysis & Testing of Materials – Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity; fatigue; endurance limit; characteristics of fatigue fracture; variables affecting fatigue life; creep; creep curve; creep fracture; 4.2 Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test. 4.3 Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography. 4.4 Corrosion of Metal And Alloys- Mechanism of corrosion, types of corrosion, corrosion prevention technique 4.5 Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electroplating and Special metallic plating	**CO4**
TSO.5a Select relevant material for the given problem. *TSO.5b* Evaluate the properties of given materials *TSO.5c* Identify the material from the given properties *TSO.5d* Use advanced material as per the given situation	**Unit-5.0 Advanced Material** 5.1 Polymers – Classification and applications; Polymerization techniques 5.2 Ceramics – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses 5.3 Composites –Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites 5.4 Biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials 5.5 Conducting and resisting materials – types, properties and applications; 5.6 Semiconducting materials – properties and applications; 5.7 Magnetic materials – Soft and hard magnetic materials and applications 5.8 Superconductors and dielectric materials – properties and applications 5.9 Smart materials-Piezoelectric, magnetostrictive and electrostrictive materials.	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

A) Course Code **: 2425303 (T2425303/P2425303/S2425303)**

B) Course Title **:** Strength of Materials for Mechanical Engg. (ME, ME (Auto))

C) Pre- requisite Course(s) **:** Physics, Engineering Mechanics

D) Rationale **:**

The effects due to action of force system on a body have already been studied in Physics/Mechanics in previous Semester/Class. Generally, Mechanical/Automobile Engineering components and members are subjected to different loading conditions, resulting into different types of stresses and strains. In this course, estimation of induced stresses and strains of determinate structures/components under action of these transverse, axial, thermal, shear loads, pressure, bending and torsion moment are performed. Moreover, this course will lay sound foundation for analysis and design of mechanical components going to be discussed in latter semesters.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

- **CO-1** Calculate direct stresses and strains in Mechanical members/components in single load situations.
- **CO-2** Determine bending moment, shear force, slope and deflection in different types of beams/ components subjected to transverse loading
- **CO-3** Calculate bending and shear stresses in different types of beams/components.
- **CO-4** Estimate shear stresses in shafts subjected to twisting moment.
- **CO-5** Calculate Stresses and deflection in helical springs.
- **CO-6** Calculate various stresses in thin pressure vessels.
- **CO-7** Calculate principal stress and strain in machine members subjected to multi-load situations.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	2	-	3	2	-	1		
CO-2	3	2	-	2	-	-	1		
CO-3	3	2	-	2	-	-	1		
CO-4	3	2	-	2	-	-	1		
CO-5	3	2	-	2	-	-	1		
CO-6	3	2	-	-	-		1		
CO-7	3	2	-	-	-		1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

J) Theory Session Outcomes (TSOs) and Units: T2425303

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Identify various types of loadings in the given component/member with justification. *TSO 1b.* Identify mechanical components subjected to single load situations. *TSO 1c.* Calculate various elastic moduli in the given situation. *TSO 1d.* Calculate direct stresses and strains in the given determinate component/member subjected to single static longitudinal, shear and thermal loads.	**Unit-1.0 Direct Stresses and Strains in Components** 1.1 Different types of Loads. 1.2 Mechanical properties of materials like Strength, Stiffness, Hardness, Toughness, Ductility, Malleability, Elasticity, Plasticity. 1.3 Statically Determinate structures. 1.4 Direct Stress, Linear Strain, Hook's Law, Stress-Strain curve of ferrous and non-ferrous materials, Modulus of Elasticity, Yield, Proof, Breaking and Ultimate Stress and Factor of safety. 1.5 Lateral Strain and Poisson's ratio, Relations between different Moduli. 1.6 Temperature Stresses and Strain with and without yielding. 1.7 Shear Stress, Shear Strain and Shear Modulus. 1.8 Bulk Modulus and Volumetric Strain	**CO1**
TSO 1e. Identify Mechanical components subjected to bending moment. *TSO 2a.* Draw Shear Force and Bending Moment Diagram for the given Statically Determinate Beam. *TSO 2b.* Identify location of point of contra flexure in the given situation with justification. *TSO 2c.* Determine deflection and slope in a given Statically determinate Beam using given method.	**Unit-2.0 Shear Force, Bending Moment, Slope and Deflection in Beam type Components** 2.1 Types of Beams like Cantilever, Simply Supported and Over Hang Beams. 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 Hang Beams. 2.6 Slope and Deflection in Cantilever and Simply Supported beams.	**CO2**
TSO 3a. Calculate the bending stress in the given beam. *TSO 3b.* Calculate Slope and Deflection in the given beam. *TSO 3c.* Calulate the shear stress behavior in the given beam.	**Unit-3.0 Bending and Shear Stresses in Beam type Components** 3.1 Bending Theory, Flexural equation, Bending stress, Bending strain, Sectional Modulus 3.2 Neutral Axis, application of Bending theory to Statically determinate beams. 3.3 Shear stress: Average and Maximum shear stress for rectangular and circular section beams. 3.4 Short members subjected to eccentric loading.	**CO3**
TSO 4a. Calculate the shear stresses in the given shaft which is subjected to pure twisting moment. *TSO 4b.* Calculate angle of twist and shear train in given solid shaft. *TSO 4c.* Calculate the power transmitted by the given solid and hollow shafts. *TSO 4d.* Select solid and hollow shaft for the given application with justification.	**Unit-4.0 Torsion of Shaft** 4.1 Torsion/Twisting Moment, Torsional Equation, Angle of Twist, Polar Moment of Inertia, Torsional Rigidity. 4.2 Torsional Stress and Strain in solid and hollow shafts. Comparison between Solid and Hollow Shafts subjected to pure torsion. 4.3 Power Transmitted /Consumed for shaft, spindle and axle of solid and hollow sections subjected to Twisting Moment.	**CO4**
TSO 5a. Calculate Stiffness, deflection and maximum stress in the given spring.	**Unit-5.0 Stresses and Deflection in Helical Springs** 5.1 Definition, types and application of springs.	**CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5b. Estimate strain energy for the given axially loaded helical spring.	5.2 Spring classification based on size, shape and load-leaf spring, helical and spiral spring. 5.3 Stiffness, deflection and maximum stress in helical open and closed coil springs only.	
TSO 6a. Identify mechanical components subjected to internal/external pressure loading. *TSO 6b.* Find out various stresses induced in the given thin pressure vessel due to internal/external pressure.	**Unit-6.0 Thin Cylindrical and Spherical Pressure Vessels** 6.1 Pressure Vessels. 6.2 Thin cylinders and spheres subjected to internal pressure; Hoop stresses, longitudinal stress and change in volume. 6.3 Wire bound thin Cylindrical pressure vessels.	**CO6**
TSO 7a. Identify multi-load situations with justifications. *TSO 7b.* Estimate principal stresses and maximum shear stress for a given combined loading by analytical Approach. *TSO 7c.* Estimate principal stresses and maximum shear stress for a given combined loading by Mohr's circle method.	**Unit-7.0 Principal Stresses** 7.1 Multi load situations and need of estimating principal stresses. 7.2 Definition of principal plane and principal stresses. 7.3 Expression for normal and tangential stress, maximum shear stress. 7.4 Stresses on inclined planes. 7.5 Position of principal planes and planes of maximum shear. 7.6 Graphical solution using Mohr's circle of Stresses.	**CO7**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425303

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use UTM to perform Tensile test. *LSO 1.2.* Plot stress-strain curve for a given material under tensile loading. *LSO 1.3.* Estimate yield strength, proof stress, ultimate strength, percentage elongation in length, percentage reduction in area. *LSO 1.4.* Use related IS Code	1.	Perform Tension Test on Mild Steel/ Aluminium on Universal Testing machine as per IS432 (I)	CO1
LSO 2.1. Use UTM to perform Compression test. *LSO 2.2.* Plot stress-strain curve for a given material under compressive loading. *LSO 2.3.* Estimate yield strength, proof stress, ultimate strength, percentage elongation in length, percentage reduction in area. *LSO 2.4.* Use related IS Code	2.	Perform Compression test on Cast Iron on Universal Testing Machine as per IS 14858	CO1
LSO 3.1. Use UTM to perform Shear test. *LSO 3.2.* Plot stress-strain curve for a given material under shear loading. *LSO 3.3.* Estimate corresponding yield strength, proof stress, and ultimate strength. *LSO 3.4.* Use related IS Code	3.	Perform direct Shear Test on Mild Steel using Universal Testing Machine as per IS 5242	CO1

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 4.1. Identify simply supported end conditions *LSO 4.2.* Correlate Young's Modulus of beam material with deflection and area moment of inertia.	4.	Determine Young's Modulus of Elasticity of different materials' beam simply supported at ends.	CO1, CO2
LSO 5.1. Use Impact machine under Izod and Charpy test situations *LSO 5.2.* Identify way to apply impact loading *LSO 5.3.* Estimate Toughness of the specimen material. *LSO 5.4.* Use related IS Code	5.	Calculate Impact Value/Toughness of Mild Steel and Aluminium using Izod and Charpy Impact Test Apparatus as per IS 1757.	CO1
LSO 6.1. Use Brinell, Rockwell and Vicker's hardness testers. *LSO 6.2.* Perform hardness test. *LSO 6.3.* Correlation of different hardness values from different tests.	6.	Perform Brinell, Rockwell and Vicker's hardness test on different metals.	CO1
LSO 7.1. Use Combined Shear Force and Bending Moment apparatus. *LSO 7.2.* Estimate Bending moment and shear force in beams. *LSO 7.3.* Estimate the point of contraflexure.	7.	Estimate Maximum Bending moment and Shear force for simply supported and cantilever beams under point load and UDL using 'Combined Shear Force and Bending Moment' apparatus.	CO2
LSO 8.1. Use using 'Slope and Deflection' apparatus *LSO 8.2.* Find out Measure flexural rigidity (EI) for a given beam *LSO 8.3.* Correlate experimental and analytical values	8.	Measure flexural rigidity (EI) for beam using 'Slope and Deflection' apparatus and compare it with theoretical value.	CO2
LSO 9.1. Use using 'Slope and Deflection' apparatus *LSO 9.2.* Investigate the effect of beam length and width on deflection of beam *LSO 9.3.* Correlate experimental and analytical values	9.	Investigate the effect of beam length and width on deflection of beam and compare it with theoretical value using 'Slope and Deflection' apparatus.	CO2
LSO 10.1. 'Torsion of Bar' apparatus *LSO 10.2.* Correlate the angle of twist, length and modulus of Rigidity of a shaft. *LSO 10.3.* Use related IS Code	10.	Perform the torsion test on wire/ Rod of different materials using 'Torsion of Bar' apparatus. (Part I) as per IS 1717	CO4
LSO 11.1. Use 'Extension and compression of Spring 'apparatus *LSO 11.2.* Estimate Stiffness of the given spring. *LSO 11.3.* Correlate the effect of spring deflection and load on strain energy stored.	11.	Measure Stiffness and deflection of given spring and Modulus of Rigidity of the spring wire using 'Extension and compression of Spring 'apparatus.	CO5

L) **Suggested Term Work and Self Learning: S2425303** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. **Assignments**: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

- Collect information about the values of different engineering properties of five standard mechanical engineering materials and present in tabular form.
- Identify simple mechanical components where single load situation exist.
- Solve numerical problems related to direct stresses and strains.
- List out different types of test that can be performed on a UTM.

A) Course Code : 2425304 (T2425304/P2425304/S2425304)

B) Course Title : Basics Thermodynamics (ME, ME (Auto))

C) Pre- requisite Course(s) :

D) Rationale :

Thermodynamics is a branch of science that deals with energy transformations and are primarily concerned with the two forms of energy heat and work. The energy transformations are governed by the various laws of thermodynamics known as zero, first, second and third laws. Applications of thermodynamics can be found in fields of refrigeration and air-conditioning to automobile. Its principles are used to design automobile engines, steam turbines, power plants, HVAC, aircraft and rockets, etc. Thus, every student of Diploma Mechanical Engineering should have a fundamental knowledge of this course.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Assess thermodynamic properties and systems.
CO-2 Apply the laws of thermodynamics to the given systems**.**
CO-3 Analyze thermodynamics cycles**.**
CO-4 Quantify the behavior of boiler based on the thermodynamic cycle**.**
CO-5 Analyze processes involving ideal gases and real substances.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	2	3	-	-	-	-		
CO-2	3	3	2	2	1	2	2		
CO-3	3	3	2	2	2	-	2		
CO-4	3	2	2	2	-	-	-		
CO-5	3	3	2	2	2	2	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2425304

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain thermodynamics & various thermodynamics processes. *TSO 1b.* Analyze heat and work. *TSO 1c.* Draw P-V and T-S diagram of different process. *TSO 1d.* Calculate internal energy and enthalpy. *TSO 1e.* Identify state through properties. *TSO 1f.* Calculate the work done by a closed system *TSO 1g.* Calculate changes in entropy using thermodynamic tables *TSO 1h.* Calculate changes in entropy for ideal gases *TSO 1i.* calculate absolute and gage pressure, and absolute temperature. *TSO 1j.* calculate changes in kinetic, potential, enthalpy and internal energy.	**Unit-1.0 Fundamental Concepts of Thermodynamics** 1.1 Thermodynamics: Terminology, definition and scope, microscopic and macroscopic approaches, Basic concepts of – State, state point, System, Boundary and Surroundings, 1.2 Identification of a state through properties Thermodynamic properties, their units and classifications. intensive and extensive various property diagrams 1.2 Mechanics definition of work and its limitations, Heat and work, Work done, sign convention, change in internal energy, change in enthalpy and entropy, Specific heats at constant volume and at constant pressure. 1.3 Thermodynamic processes of ideal gases. Isobaric, Isochoric, Isothermal, Adiabatic and polytropic with representation on P-V and T-S diagram. 1.4 General gas equation, Characteristics of gas constant, Mol of gas, Universal gas constant, specific heats of ideal gases. 1.5 Thermodynamic equilibrium, Reversibility and irreversibility, Quasi-static process	**CO1**
TSO 2a. Apply zeroth law of thermodynamics to a given thermodynamic system. *TSO 2b.* Apply first law of thermodynamics to a given thermodynamic system. *TSO 2c.* Calculate thermal efficiency & C.O.P. for a given thermodynamic cycle *TSO 2d.* Apply third law of thermodynamics to a given thermodynamic system *TSO 2e.* Explain Steady flow energy equation and their application *TSO 2f.* Apply second law of thermodynamics to a given thermodynamic system *TSO 2g.* Analyze systems and control volumes through the application of the second law	**Unit-2.0 Law of Thermodynamics** 2.1 Zeroth and first law of thermodynamics, Statement of the First law of thermodynamics for a cycle Steady flow energy equation and their application. 2.2 Derivation of the First law of processes, energy, internal energy as a property 2.3 Concept of heat source and heat sink, heat reservoir, heat engine, heat pump and refrigerator 2.4 Statement of the second law of thermodynamics: - Kelvin Planck Statement, Clausius Statement and their equivalence, heat engine, heat pump, refrigerator and simple numerical on thermal efficiency and COP. 2.5 Statement of the third law of thermodynamic	**CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Describe types of thermodynamics cycle. *TSO 3b.* Draw P-V and T-S diagram of Carnot cycle *TSO 3c.* Calculate thermal efficiency of Carnot cycle. *TSO 3d.* Draw P-V and T-S diagram of cycle and Brayton cycle. *TSO 3e.* Calculate air standard efficiency of different cycle *TSO 3f.* Analyze the Carnot, Otto, and Rankine thermodynamic cycles.	**Unit-3.0 Thermodynamic Cycles** 3.1 Classifications of thermodynamic cycle. 3.2 Carnot cycle and its representation on P-V and T-S diagram. 3.3 Derivation of thermal efficiency of Carnot cycle and simple numerical based on it. 3.4 Concept of air standard efficiency of Otto, Diesel, and Brayton cycle (Without derivation), representation on P-V & T-S diagram.	**CO3**
TSO 4a. Describe steam and their phases. *TSO 4b.* Calculate dryness fraction and degree of superheat. *TSO 4c.* Calculate enthalpy of steam using steam table. *TSO 4d.* Explain given type of boiler, mountings and their accessories. *TSO 4e.* Identify different components of given boiler	**Unit-4.0 Properties of Steam and Steam Power** 4.1 Formation of steam, various phases like wet steam, dry saturated Steam, superheated steam. 4.2 Dryness fraction, degree of superheat, sensible heat, Latent heat, calculation of enthalpy of wet, dry saturated & superheated steam using steam table. 4.3 Steam boilers: Classification, Construction and working of Cochran, Babcock and Wilcox, Lamont and Loeffler boiler. Mountings – Bourdon Pressure Gauge, Safety valves, Water level Indicator and fusible Plug. Accessories – Economizer, super heater and air pre-heater.	**CO4**
TSO.5a Sketch P-v, T-v, and P-T plots for steam, R-134a, and ideal gases. *TSO.5b* Locate data states on P-v, T-v, and P-T plots for steam, R-134a, and ideal gases *TSO.5c* Apply the concept of the generalized compressibility factor to determine the state of a gas *TSO.5d* Apply the ideal gas equation to solve problems involving pressure, temperature, and volume of ideal gases *TSO.5e* Analyze processes involving ideal gases and real substances as working fluids in both closed systems and open systems *TSO.5f* Determine the properties of pure substances using thermodynamic tables *TSO.5g* Calculate changes in entropy using thermodynamic tables. *TSO.5h* Calculate changes in entropy for ideal gases	**Unit-5.0 Pure Substances, Ideal & Real Gases** **Ideal and perfect gases** 5.1 Differences between perfect, ideal and real gases, equation of state, evaluation of properties of perfect and ideal gases. 5.2 Real Gases: Introduction. Vander Waal's Equation of state, Van der Waal's constants in terms of critical properties, law of corresponding states, compressibility factor, compressibility chart **Pure Substances** 5.3 Definition of a pure substance, phase of a substance, triple point and critical points, sub-cooled liquid, saturated liquid, vapor pressure, two-phase mixture of liquid and vapor, saturated vapor and superheated vapor states of a pure substance 5.4 Representation of pure substance properties on p-T and p-V diagrams, detailed treatment of properties of steam for industrial and scientific use	**CO5**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425304

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use of thermometer and pressure gauge.	1.	Calibrate thermometers and pressure gauges	CO1
	2.	Compare the accuracy and characteristics response of the different types of thermometers.	CO1
	3.	Determine the pressure with a bourdon tube pressure gauge	CO1
	4.	Determine the pressure with different pressure measuring devices and then compare the measured values	CO1
LSO 2.1. Use working models of petrol engine/ diesel engine	5.	Use model of cross-sectional view of given petrol engine to identify different parts and components of the engine	CO2
	6.	Use model of cross-sectional view of given diesel engine to identify different parts and components of the engine	CO2
LSO 2.2. Use heat pump	7.	Determine the power input, power output as well coefficient of performance of heat pump	CO2
LSO 2.3. Use steam turbine	8.	Operate impulse and reaction steam turbines.	CO2
	9.	Determine power output & efficiency of a steam turbine	CO2
	10.	Determination of steam flow rate of a steam turbine	CO2
LSO 2.4. Use condenser	11.	Find the efficiency of the given condenser	CO2
LSO 3.1. Use steam engine	12.	Determine the brake power of a single cylinder steam engine with varying load	CO3
LSO 3.2. Use heat Engine	13.	Investigate the first law and Second law of thermodynamic using heat Engine	CO3
LSO 4.1. Use separating and throttling calorimeter	14.	Find dryness fraction of steam by separating and throttling calorimeter.	CO4
LSO 4.2. Use working models of different types of boilers.	15.	Identify low pressure boilers and their accessories and mountings.	CO4
	16.	Identify high pressure boilers and their accessories and mountings.	CO4
	17.	Prepare heat balance sheet for given boiler.	CO4
	18.	Investigate the relationship between pressure and temperature of saturated steam.	CO4
	19.	Carry out fault finding on Boiler control demonstration unit.	CO4
LSO 4.3. Use air-Water-Steam Heat Exchanger	20.	Determine the mean temperature difference between two mediums in both contra and parallel flow using air-Water-Steam Heat Exchanger	CO5
	21.	Plot the temperature difference curves for a variety of flow conditions using air-Water-Steam Heat Exchanger	CO5

A) Course Code **: 2425305 (P2425305/S2425305)**

B) Course Title **:** Computer Aided Drafting and Modelling (ME, ME (Auto))

C) Pre- requisite Course(s) **:** Engineering Drawing

D) Rationale **:**

With the emergence of computer-aided drafting and design (CAD) tools the traditional engineering drawing practices has undergone significant change as the emphasis has shifted from drawing board-based engineering practices to Computer aided based drafting and modeling which has the advantages of speed, modification, storage and convenience of drawing complex 2D and 3D entities. This course makes them able to use computer aided drafting and design software for developing 2D & 3D digital entities, Digital engineering drawings and Assemblies related to different fields. The goal of this course is to make the student proficient in the most up-to-date drafting, solid modeling and assembly practices through providing them with hands-on experience.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Use Computer Aided Drafting software to draw simple and complex 2D geometric entities.

CO-2 Use Computer Aided Drafting software to draw orthographic and isometric projections.

CO-3 Use Computer Aided Design Software to model 3D components and assemblies.

CO-4 Use Computer Aided Design Software to create engineering drawings of machine components and assemblies.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	3	1	1	2		
CO-2	3	-	1	3	1	1	2		
CO-3	3	1	1	3	-	1	2		
CO-4	3	-	-	3	-	1	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

J) Theory Session Outcomes (TSOs) and Units:

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Use the given computer aided drafting software for creating the institute Drawing Template. *TSO 1b.* Use drawing commands to create the given simple 2D geometry. *TSO 1c.* Apply drawing aids, coordinate system, selection methods, and templates to create the given drawing quickly and precisely. *TSO 1d.* Use the given computer aided drafting software for creating the given simple 2D entity.	**Unit-1.0 Basic Computer Aided Drafting** 1.1 Various Software for Computer Aided Drafting and Computer Aided Design. 1.2 Basics of AutoCAD or any other drafting software–interface, screen layout, starting commands from menus, command line. 1.3 Coordinate system, Angular measurements, Point specification. 1.4 Drawing aids - Grid, Snap, Ortho, Osnap, Units, Limits, Layers, Linetype. 1.5 Opening and Saving drawing files. 1.6 Creating User Defined Templates. 1.7 Methods of Selecting and deleting Objects. 1.8 Undo and Redo. 1.9 Creating basic drawings objects - lines, arc, circles, ellipses, polyline and polygons.	**CO1**
TSO 2a. Use modifying commands to create the given complex 2D entity. *TSO 2b.* Use hatching, text and dimensioning, tolerance and formatting commands to make the given complex 2D drawings. *TSO 2c.* Use layers and blocks to handle complex 2D drawings. *TSO 2d.* Use the given computer aided drafting software for creating the given complex 2D entity. *TSO 2e.* Print the given drawing (using institute template) on A4/A3 sheet.	**Unit-2.0 Advanced Computer Aided Drafting** 2.1 Modify 2D entities: Erase, Trim, Extend, Copy, Move, Mirror, Offset, Fillet, Chamfer, Array, Rotate, Scale, Lengthen, Stretch, Break, Divide, Exploded and Block, Hatch etc. 2.2 Text and Dimensioning, Dimensional tolerances and Geometrical tolerances. 2.3 Formatting commands- Line weight, Color, Line type, Dimension style. 2.4 Controlling Drawing display. 2.5 Layers: concept and application. 2.6 Printing and plotting of drawings- Paper space, Model space, creating table, Plot commands.	**CO1**
TSO 3a. Use the given computer aided drafting software for creating orthographic views of the given object. *TSO 3b.* Use the given computer aided drafting software for creating isometric views of the given object.	**Unit-3.0 Application of Computer Aided Drafting** 3.1 Drawing orthographic views using drafting software with principles mentioned in 'Engineering Drawing' Course. 3.2 Drawing isometric views using drafting software with principles mentioned in 'Engineering Drawing' Course.	**CO1, CO2**
TSO 4a. Explain solid modeling, surface modeling and assembly operation in the available CAD software. *TSO 4b.* Use the given computer aided Design software to create 2D entities with constraints and parametric relations.	**Unit-4.0 Computer Aided Design Software- Working in 2D Environment** 4.1 Introduction, features, and applications of different software packages used for solid modeling. System requirement & compatibility with other software. 4.2 Working in Sketcher mode - Line, Profile, Circle, Arc, curves, Rectangle, and their sub options. 4.3 Constraints-Dimensioning constraint, Geometrical constraint.	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5a. Create the given 3D model (part) using the given commands and parametric relations. *TSO 5b.* Describe the procedure to use 3D modify commands to edit the given 3D Model. *TSO 5c.* Create assembly of the given 3D solid (Part) models using the CAD software. *TSO 5d.* Modify the given assembly using the CAD software. *TSO 5e.* Describe the procedure to use explode command for the given assembly.	**Unit-5.0 Computer Aided Design Software-Solid Modeling and Assembly** 5.1 Introduction to Computer Aided Design Software and different modules. 5.2 Working in 3D environment 5.3 Creating 3D Solid Models of simple and complex machine parts using Extrude, Revolve, Sweep, variable section sweep, Draft, loft, Blend, creating reference planes, points and lines, and similar 3D commands. 5.4 Part editing tool: Trim, Extend, Erase, Mirror, Chamfer, Round, Copy, Move, Draft, Boolean operations, Patterns, etc. 5.5 Parametric and non parametric modeling-concept, differences and illustration. 5.6 Preparation of assemblies using assembly commands. Introduction to Top down and Bottom-up approach of assembly 5.7 Exploded view: Explode the assembly.	**CO3**
TSO 5f. Describe the procedure to generate 2D drawings of the given part models and assembly using the CAD software. *TSO 6a.* Plot production drawing as per the given dimensions, parts and assemblies.	**Unit-6.0 Drafting and Plotting using Computer Aided Design Software** 6.1 Generate orthographic projections from already available Part Models and Assemblies. All types of views – front view, top view, side view, sectional views, isometric views, auxiliary views. 6.2 Dimensioning Commands – Apply dimensions, dimensional and geometrical tolerances. 6.3 Preparation of Assembly drawing using assembly features. 6.4 Working in Drafting Mode. 6.5 Bill of material – Prepare part list table and name plate. 6.6 Page set up, Plot command.	**CO4**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use the given Computer aided Drafting software. *LSO 1.2.* Draw standard 2D entities using Draw commands.	1.	Use the Computer Aided Drafting software to draw following simple 2-D entities using Draw commands • Draw circle and arcs with different geometric conditions and constraints (two problems). • Draw polygons (Triangle, square, pentagon, hexagon, heptagon) (Three problems).	CO1
LSO 2.1. Customize the given Computer aided drafting software as per requirements. *LSO 2.2.* Use readymade templates to draw 2D entities.	2.	• Use customization tool bar of CADr software to customize main window and to do interfacing. • Use existing standard 2D drawing templates.	CO1
LSO 3.1. Use the given Computer aided Drafting software to create template as per requirement. *LSO 3.2.* Insert already prepared 2D entities in the template using modify commands	3.	Prepare a template for your institute of A-4 size with title block and institute logo using the Computer Aided Drafting software.	CO1
LSO 4.1. Estimate areas and perimeters of regular and complex 2D entities using software.	4.	Use the Computer Aided Drafting software to estimate Area, Perimeter, and Centroid for the given 2D entities like Circle, Pentagon, Trapezium, hexagon and 2D entity with arcs and spline curves using 'Enquiry' and 'List' commands.	CO1
LSO 5.1. Draw conic sections using software. *LSO 5.2.* Draw popular engineering curves for engineering applications.	5.	Use the Computer Aided Drafting software to draw: • Ellipse and parabola • Epicycloid and Hypocycloid curves using pitch circle as directing circle of a cycloidal gear and an appropriate size smaller circle as generating circle • Involute of a circle	CO1
LSO 6.1. Use various Draw, Edit and Modify commands to create complex 2D entities.	6.	Use the Computer Aided Drafting software to draw four complex 2D entities assigned by the teacher using Draw, Edit and Modify commands	CO1
LSO 7.1. Use Computer aided Drafting software to create and modify 2D entities. *LSO 7.2.* Use computer aided drafting software to create and modify the given orthographic views.	7.	Use the Computer Aided Drafting software to draw Orthographic projections of following using first angle method: • A pentagonal pyramid is placed in first quadrant with its axis parallel to H.P. and V.P • A frustum of a hexagonal is placed in first quadrant with its axis perpendicular to H.P. and parallel to V.P • Different objects having cylindrical surfaces, ribs.	CO2
LSO 8.1. Use computer aided drafting software to create and modify the given orthographic views of mechanical components.	8.	Use the software to draw Orthographic projections of following using first angle method: • Front and side view of V-Groove Pulley • Front view of 2-Wheeler Piston • Front view of typical Open-Ended Spanner • Front view of Connecting Rod (similar objects can be taken up)	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 9.1. Use dimensional and Geometric tolerance and text to the given 2D drawing.	9.	Apply geometrical tolerance, dimensional tolerance and text to the drawing drawn under Sr. No. 6 to 8.	CO1
LSO 10.1. Use of layer to handle complex 2D entities.	10.	Use the software to draw sectional view of piston of a two-wheeler. Main drawing of Piston in one layer, hatching in another layer and dimensioning and text in third layer	CO1
LSO 11.1. Use computer aided drafting software to create and modify the given isometric entities.	11.	Use the software to draw isometric views of three 3D objects containing lines, arcs, circles, holes, ribs and slots	CO2
LSO 12.1. Visualize the 3D shape of the given object. *LSO 12.2.* Convert the given 2D figures/views into isometric views.	12.	Convert the orthographic views of an object to isometric view (Two problems)	CO2
LSO 13.1. Print drawing on A4 and A3 papers with dimensions and text.	13.	Print any three drawings from above list along with the template of institute prepared.	CO1
LSO 14.1. Use the given Computer Aided Design (CAD) Software *LSO 14.2.* Customize the given CAD Software *LSO 14.3.* Create simple 3D parts models using the given CAD Software	14.	• Customize main window and interface of the 3D modeling software using customization tool bar. • Create given simple part models using commands like Extrude, Revolve, Shell etc.;	CO3
LSO 15.1. Create Complex 3D parts models using the given CAD Software	15.	Create the given complex 3D part model(s) using advanced commands like Sweep, Variable Section Sweep, Blend, Draft, Mirror, Chamfer, Fillet, Rib, Pattern etc.	CO3
LSO 16.1. Create Simple mechanical 3D parts models using the given CAD Software	16.	Develop following mechanical components: • Stepped shaft • Muff coupling • Hexagonal nut • Hexagonal bolt • Cast Iron Pulley	CO3
LSO 17.1. Create mechanical 3D parts models and assemblies using the given CAD Software	17.	Develop following mechanical components and assemblies: • Cotter joint • Flange coupling • Screw jack • Tool Post • Bench vice • Plummer Block • Drill Jig • (OR any six similar components)	CO3
LSO 18.1. Print Production drawings related o mechanical components and assemblies using the given CAD software.	18.	• Print orthographic views (regular and sectioned) of the solid models developed under Sr. No. 16 • Print drawing of the solid models developed Sr. No. 16 • Print drawing of the assembly developed Sr. No. 17 with Bill of Materials.	CO4

A) Course Code : 2425306 (P2425306/S2425306)

B) Course Title : Summer Internship -I (Common For all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

- **CO-1** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- **CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- **CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- **CO-4** Identify the probable job function and job position in their relevant programme of study.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	1	-	-	1		
CO-2	3	-	-	1	-	-	1		
CO-3	3	-	-	-	1	-	2		
CO-4	3	-	-	-	1	-	2		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

A) Course Code : **2400207 (T2400207 / S2400207)**

B) Course Title : Indian Constitution (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Enumerate salient features and characteristics of the constitution of India.

CO-2 Follow fundamental rights and duties as responsible citizen and engineer of the country.

CO-3 Analyze major constitutional amendments in the constitution.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	1	-	-	-	2	-	-		
CO-2	1	-	-	-	2	-	-		
CO-3	1	2	-	-	2	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400207	Indian Constitution	01	-	-	-	01	01

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture(L), Tutorial(T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits= (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
		Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
		Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
2400207	Indian Constitution	25	-	25	-	-	-	50

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

I) 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), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400207

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the meaning of preamble of the constitution. TSO 1b. List the salient features of constitution. TSO 1c. List the characteristics of constitution.	**Unit-1.0 Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspective of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble to the Constitution of India.	**CO1**
TSO 2a. Enlist the fundamental rights. *TSO 2b.* Identify fundamental duties in general and in particular with engineering field. *TSO 2c.* identify situations where directive principles prevail over fundamental rights.	**Unit-2.0 Fundamental Rights and Directive Principles** 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance. 2.3 Relevance of Directive Principles of State Policy under part-IV.	**CO2**
TSO 3a. Enlist the constitutional amendments. *TSO 3b.* Analyze the purposes of various amendments.	**Unit-3.0 Governance and Amendments** 3.1 Amendment of the Constitutional Powers and Procedure 3.2 Major Constitutional Amendment procedure - 42nd, 44th, 74th, 76th, 86th and 91st	**CO3**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) Suggested Term Work and Self Learning: S2400207

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Role of Media in Spreading Awareness regarding Fundamental Rights
2. Analysis of Situations where directive principle of State policy has prevailed over Fundamental rights
3. Analyze 42nd and 97th Amendment of Indian Constitution

c. Other Activities:

1. Seminar Topics:
- Democracy and Political Participation in India
- Situations where directive principles prevail over fundamental rights.

2. Visits:
    - Arrange Mock Parliament.

3. Design games and simulation on emergencies declared in last thirty years.

A) Course Code : **2400108 (T2400108)**

B) Course Title : Essence of Indian Knowledge System and Tradition (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

This course will survey the basic structure and operative dimensions of Indian knowledge system. With the new education policy-NEP 2020 focusing on Indian Knowledge Systems (IKS) and Traditions of India. This course introduces the learners to the rich and varied knowledge traditions of India from antiquity to the present. This also helps the learner to know and understand their own systems and traditions which are imperative for any real development and progress. Also, it helps the learner to think independently and originally adopting Indian frameworks and models for solving the problems related to world of work where the student is supposed to perform.

E) Course Outcomes (COs): After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

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

CO-1 Identify the rich heritage and legacy residing in our Indian Knowledge systems.

CO-2 Correlate the technological & philosophical concepts of IKS with engineering domain specific problems and local problems for finding out possible solutions.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	2	-	-	-	1	1	1		
CO-2	1	2	2	-	3	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400108	Essence of Indian Knowledge System and Tradition	01	-	-	-	01	01

J) Theory Session Outcomes (TSOs) and Units: T2400108

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the architecture of the Ancient Indian Knowledge Systems. *TSO 1b.* List the salient features of IKS. *TSO 1c.* Comprehend the given IKS model. *TSO 1d.* Identify the role and relevance of the given IKS model in contemporary society.	**Unit-1.0 Introduction to Indian Knowledge Systems** 1.1 Overview of IKS 1.2 Organization of IKS – चतुर्दश-विद्यास्थानं 1.3 Conception and Constitution of Knowledge in Indian Tradition 1.4 The Oral Tradition 1.5 Models and Strategies of IKS	**CO1**
TSO 2a. Enlist the importance of Veda, Vedanga, Visaya, Siksaka. *TSO 2b.* Describe the given IKS domain. *TSO 2c.* Identify elements of mentioned IKS domains that are relevant to Technical Education System. *TSO 2d.* Correlate the elements of mentioned IKS domains with given engineering domain.	**Unit-2.0 Overview of IKS Domains and Relevance in Current Technical Education System.** 2.1 The Vedas as the basis of IKS 2.2 Overview of all the six Vedāṅgas 2.3 Relevance of following IKS domains in present Technical Education System: • Arthashastra (Indian economics and political systems) • Ganita and Jyamiti (Indian Mathematics, Astronomy and Geometry • Rasayana (Indian Chemical Sciences) • Ayurveda (Indian Biological Sciences / Diet & Nutrition) • Jyotish Vidya (Observational astronomy and calendar systems) • Prakriti Vidya (Indian system of Terrestrial/ Material Sciences/ Ecology and Atmospheric Sciences) • Vastu Vidya (Indian system of Aesthetics-Iconography and built-environment /Architecture) • Nyaya Shastra (Indian systems of Social Ethics, Logic and Law) • Shilpa and Natya Shastra (Indian Classical Arts: Performing and Fine Arts) • Sankhya and Yoga Darshna (Indian psychology, Yoga and consciousness studies) • Vrikshayurveda (Plant Science / Sustainable agriculture/food preservation methods)	**CO1, CO2**

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) Suggested Term Work and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.