Curriculum

of

Diploma Programme

in

Electrical Engineering

State Board of Technical Education (SBTE)
Bihar

Semester – IV
Teaching & Learning Scheme

Board of Study	CourseCodes	CourseTitles	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				
	2420401	**Power Electronics**	3	-	4	2	9	6
	2420402	**Microprocessor and Microcontrollers**	3	-	4	2	9	6
	2420403	**A C Machines**	3	-	4	2	9	6
	2420404	**Control System and PLC**	3	-	4	2	9	6
	2420405	**Electrical Software Lab** (Drawing & CAD, MATLAB & Simulink)	-	-	4	2	6	3
	2400107	**Professional Ethics** (Non-exam course)	1	-	-	-	1	1
	2400207	**Indian Constitution** (Common for All Programmes)	1	-	-	-	1	1
	2400108	**Essence of Indian Knowledge System and Tradition** (Common for All Programmes)	1	-	-	-	1	1
Total			**15**	**-**	**20**	**10**	**45**	**30**

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.

A) Course Code : **2420401(T2420401/P2420401/S2420401)**

B) Course Title : Power Electronics

C) Pre- requisite Course(s) : Fundamentals of Electronics Engineering/Basic Electrical Engineering/Electrical Circuit and Network

D) Rationale :

Power electronics deals with the applications of solid-state electronics for processing of high voltages and currents to deliver power that supports a variety of needs of modern Industrial and domestic applications. The function of power electronics is to convert and control the electric power with converters modifying the primary characteristics of electrical power such as voltage, current and frequency in a form that is optimally suited to the load. Power electronics also play a crucial role in the integration of renewable energy sources into the electrical grid by enabling efficient and reliable power conversion, improved grid integration, and increased adoption of renewable energy sources. In this era of industrial automation and with the advancement of power electronics devices, the conventional control and relays have now become obsolete and are replaced by electronic control and relays, employing solid state power semiconductor devices. This core course is designed to provide essential theoretical and practical skills to use power electronics to control electrical machines and devices in commercial and industrial sector.

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, Psycho motor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Test the performance of Power Electronics devices.
CO-2 Maintain Turn on and Turn off circuit for a thyristor.
CO-3 Use relevant Phase Controlled rectifier for a given situations.
CO-4 Select a suitable chopper for a given applications.
CO-5 Test the performance of inverter, Cycloconverter and AC voltage controller.

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/ Developmen tof 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	3	2	1	1	2		
CO-2	3	2	2	2	1	1	2		
CO-3	3	3	1	2	1	1	2		
CO-4	3	3	1	2	1	1	2		
CO-5	3	2	3	3	1	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

J) Theory Session Outcomes (TSOs) and Units: T2420401

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Sketch standard symbol of the given Power electronic devices. *TSO 1b.* Explain the working principle of the given power electronic devices with the help of characteristic curve. *TSO 1c.* Explain different protection circuits used in SCR. *TSO 1d.* Interpret the characteristics of the given power electronic devices. *TSO 1e.* Describe the procedure to choose suitable power electronic device for the given switching application.	**Unit-1.0 Power Electronics Devices.** 1.1 Silicon Controlled Rectifier (SCR): Construction, principle of operation, characteristic curve, two transistor analogy, Switching characteristics and triggering methods. 1.2 Rating and Protection: over voltage, over current, snubber circuit. 1.3 Series and parallel operation of SCRs: String efficiency. 1.4 DIAC, TRIAC: Construction, Operation, characteristic curves and applications. 1.5 Power BJT, MOSFET, IGBT: Construction, Operation, characteristic curves and applications.	**CO1**
TSO 2a. Explain the given triggering method of SCR. *TSO 2b.* Explain the given turn off method of SCR. *TSO 2c.* Describe the given class of commutation circuit.	**Unit-2.0 Turn-on and Turn-off methods of Thyristors** 2.1 SCR Turn-on methods: High Voltage triggering, thermal triggering, illumination triggering, dv/dt triggering, Gate triggering 2.2 Gate trigger circuits: Resistance and Resistance capacitance circuits, 2.3 SCR triggering using UJT Relaxation Oscillator and Synchronized UJT circuits. 2.4 SCR Turn-Off methods: Natural and forced commutation, 2.5 Class A, Class B, Class C, Class D commutation.	**CO1, CO2**
TSO 3a. Determine the average output voltage for a single-phase half wave controlled rectifier for the given load. TSO 3b. Explain the working principle of full converter for the given load, with and without freewheel diode. TSO 3c. Justify the need of freewheeling diode in converter. TSO 3d. Explain working & various waveform of single-phase semi converter for various loads. TSO 3e. Explain the working of three phase half wave-controlled converter with a neat sketch for the given load. TSO 3f. Explain the working of a Dual converter TSO 3g. Describe the procedure to select a suitable converter for the given application	**Unit-3.0 Phase Controlled Rectifier** 3.1 Phase control: firing angle, conduction angle 3.2 Single Phase Fully Controlled Half Wave Converter: With R, RL and RLE load: Circuit diagram, working, input- output waveform, equations for DC outputs. 3.3 Single-phase full-wave mid-point and bridge converter with R load, RL load, RL load with DC source: Circuit diagram, working, input- output waveform, equations for DC outputs 3.4 Single-phase semi converter with R, RL load with DC source: Circuit diagram, working, input-output waveform, equations for DC outputs 3.5 Three-phase half wave converter with R load: Circuit diagram, working, input- output waveform. 3.6 Three-phase full wave converter with R load: Circuit diagram, working, input- output waveform. 3.7 Dual Converter.	**CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4a. Explain the given control techniques of Chopper *TSO 4b.* Classify choppers based on the given criteria. *TSO 4c.* Explain the working principle and waveforms for the given type of chopper along with neat sketches. *TSO 4d.* Calculate duty cycle, output voltage and other parameters for the given type of chopper *TSO 4e.* Explain working principle of the given Class of chopper along with neat sketches. *TSO 4f.* Explain the working of Buck, Boost and Buck boost converter. *TSO 4g.* Explain the given commutation method of chopper.	**Unit-4.0 Chopper** 4.1 Chopper: Working Principle and its applications 4.2 Control Techniques: Constant Frequency and Variable Frequency System 4.3 Classification of Choppers: - Step Up and Step-down choppers - Class A, Class B, Class C, Class D and Class E chopper 4.4 Buck, Boost and Buck-boost converter 4.5 Commutation methods of chopper: Load commutation and Auxiliary commutation.	**CO2, CO4**
TSO 5a. Explain working of the given type of bridge inverter for R and RL loads. *TSO 5b.* Explain the working of series and parallel inverter. *TSO 5c.* Describe Voltage Source and Current Source Inverter. *TSO 5d.* Explain working of three phase VSI in 180' and 120'mode with the help of various waveforms. *TSO 5e.* Explain the given Voltage control methods of Inverter. *TSO 5f.* Describe the given type of single phase Cycloconverter giving its application. *TSO 5g.* Explain working principle of single phase Cyclo converter (Midpoint and bridge configuration with R load). *TSO 5h.* Describe working principle and application of single-phase AC voltage controller.	**Unit-5.0 Inverter, Cycloconverter and AC Voltage Controller** 5.1 Single Phase Bridge Inverter - Half and full bridge inverter with R and RL load. 5.2 Basic series and parallel Inverter - Operation and its application. 5.3 Voltage and Current Source Inverter 5.4 Three phase bridge inverters: Three phase 180 Degree mode VSI Circuit diagram, working, input- output wave forms. 5.5 Three phase 120-Degree mode VSI Circuit diagram, working, input- output wave forms. 5.6 Voltage control methods (Pulse Width Modulation techniques) of Inverter - Single pulse width modulation - Multiple pulse width modulation - Sinusoidal pulse width modulation 5.7 Single phase Cyclo-converter: working principle of Midpoint and bridge Configuration with R load. 5.8 Step up and step-down single phase Cyclo-converter and its applications. 5.9 Working principle and applications of a single-phase AC voltage controller.	**CO5**

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

A) Course Code : **2420402(T2420402/P2420402/S2420402)**

B) Course Title : Microprocessor and Microcontroller

C) Pre-requisite Course(s) : Fundamentals of Electronics Engineering

D) Rationale:

Microprocessor and Microcontroller as a course is at the core of automation in industrial, domestic, consumer goods and other high-end products. Diploma engineers have to understand and apply the concepts of various microprocessor and microcontroller-based systems and maintain them. This course is meant to provide the basic and holistic approach and develop skills to electrical diploma holders for solving the microprocessor and microcontroller-based application problems related to automation systems.

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 Analyze the architecture of Microprocessor IC 8085.

CO-2 Develop the assembly language programs for various operations using instruction set of 8085 Microprocessor.

CO-3 Interface the memory and I/O devices to 8085 Microprocessor.

CO-4 Analyze the architecture of Microcontroller IC 8051.

CO-5 Develop the assembly language programs for various operations using instruction set of 8051 Microcontroller.

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			
CO-2	3	3	3	2	-	2	2		
CO-3	3	2	3	-	-	2	2		
CO-4	3	2	2	-	-	1	-		
CO-5	3	3	3	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.

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	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**				
Electronics Engineering	**2420402**	Microprocessor and Microcontroller	03	-	04	02	09	06

J) Theory Session Outcomes (TSOs) and Units: T2420402

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Interpret the general-purpose microprocessor. *TSO 1b.* Explain the architecture of 8085 microprocessor with block diagram. *TSO 1c.* Explain various types of interrupts.	**Unit-1.0 Microprocessor 8085** 1.1 Evolution of Microprocessors 1.2 Architecture and Pin Diagram of 8085 1.3 Timing Diagram 1.4 Memory Organization 1.5 Interrupts	**CO1**
TSO 2a. Classify the different types of instruction used in 8085. *TSO 2b.* Differentiate addressing modes of 8085 microprocessor. *TSO 2c.* Differentiate addressing modes of 8085 microprocessor. *TSO 2d.* Use various types of instruction to write ALP.	**Unit-2.0 Instruction Set and Assembly Language Programming Of 8085 Microprocessor** 2.1 Instruction Set: • Data transfer instructions • Control instructions • Arithmetic instructions • Logical instructions • Branching instructions 2.2 Different types of addressing modes: • Immediate addressing mode • Register addressing mode • Direct addressing mode • Indirect addressing mode • Indexed addressing mode 2.3 Assembly Language Programming	**CO1, CO2**
TSO 3a. Interface Intel PPI 8255 with 8085. *TSO 3b.* Interface various memory chips with 8085 microprocessors. *TSO 3c.* Explain the operation of interfacing chips. *TSO 3d.* Differentiate between the serial and parallel communication modes of 8085 microprocessor.	**Unit-3.0 Interfacing with 8085 Microprocessor:** 3.1 Programmable Peripheral Interface (PPI) IC -Intel 8255 (Generation of I/O Ports) 3.2 Programmable Interval Timer ICs (Intel 8253/8254) 3.3 Overview of memory chips and their interfaces 3.4 Overview of other interfacing chips (Name and Application(s) only)	**CO1, CO3**
TSO 4a. Explain the architecture of 8051 microcontroller with block diagram representation. *TSO 4b.* Describe special function registers. *TSO 4c.* Explain the memory and I/O interfacing of 8051 microcontroller *TSO 4d.* Explain various types of operands with addressing.	**Unit-4.0 Overview of Microcontroller 8051:** 4.1 Comparison of Microprocessors and Microcontrollers 4.2 Architecture of 8051 Microcontroller 4.3 Memory organization 4.4 Special Function Registers (SFRs) 4.5 Port Operation 4.6 Memory Interfacing 4.7 I/O Interfacing 4.8 Programming 8051 resources, interrupts 4.9 Programmer's model of 8051 4.10 Operand types, Operand addressing	**CO4**
TSO 5a. Difference between high level language and low-level language. *TSO 5b.* Select structure of assembly language. *TSO 5c.* Explain the different microcontroller developing tools. *TSO 5d.* Explain different assembler directives. *TSO 5e.* Develop simple programmes using 8051 instructions.	**Unit 5 Programing with 8051** 5.1 Instruction set 5.2 Data transfer instructions 5.3 Arithmetic instructions 5.4 Logic instructions 5.5 Control transfer instructions 5.6 Boolean instructions 5.7 Timer & counter programming 5.8 Interrupt programming	**CO4, CO5**

Note: One major TSO may require more than one theory session/period.

A) Course Code : **2420403(T2420403/P2420403/S2420403)**

B) Course Title : AC Machines

C) Pre- requisite Course(s) : Basic Electrical Engineering, DC Machines and Transformer, Electrical measurements and Instrumentation

D) Rationale :

Electrical Engineering diploma holders are expected to apply the principle of electromechanical energy conversion in operating, testing and troubleshooting different types of AC machines including special machines. This course will enable them to develop a set of knowledge, skills and attitude for maintaining 3 phase and single-phase induction motor, Synchronous machines and special electrical machines taking appropriate safety measures. This course fundamentally aims at familiarizing the students with the fundamentals of various AC machines and special electrical machines and their applications. This is also a prerequisite course for mastering in Electrical drives.

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 Maintain three phase Induction Motor.

CO-2 Use relevant Single-phase Induction Motors for various applications.

CO-3 Synchronize an alternator with bus bar/another alternator.

CO-4 Use synchronous motors for industrial applications.

CO-5 Use special electrical machines for different applications.

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/ Developmentof 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	3	2	1	1	2		
CO-2	3	3	3	2	1	-	2		
CO-3	3	3	3	2	3	3	2		
CO-4	3	3	3	2	1	-	2		
CO-5	3	2	3	2	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: T2420403

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe the constructional details of three phase induction motor. TSO 1b. Explain the working principle of the given Induction motor TSO 1c. Classify the Induction machine on the basis of rotor. TSO 1d. Interpret torque slip characteristics of the given three phase induction motor. TSO 1e. Justify the need of different types of starters used in Induction motor TSO 1f. Describe the procedure to control the speed of the given Induction motor. TSO 1g. Describe the maintenance procedure of the given 3 phase induction motor. TSO 1h. Describe the Selection procedure of three phase induction motor for the given applications.	**Unit-1.0 Three Phase Induction Motor** 1.1 Construction and working principle 1.2 Slip and slip speed 1.3 Types-Squirrel cage and Slip ring Induction motors 1.4 Equivalent circuit and phasor diagram 1.5 Torque equation, Starting, running and condition for the maximum torque (Only expression) 1.6 Starter and its necessary 1.7 Types of starters- DOL, Star Delta, Autotransformer and rotor resistance starter 1.8 No load and Blocked rotor test, Losses and efficiency 1.9 Speed control of squirrel cage and slip-ring induction motor: stator voltage, pole changing, rotor resistance and Variable Voltage and Variable Frequency (VVVF) 1.10 Maintenance procedure, Rewinding of three phase induction motor 1.11 Motors selection for different applications as per the load torque speed requirements	**CO1**
TSO 2a. Explain the construction and working principle of a single-phase induction motor. *TSO 2b.* Classify the single-phase induction motor based on different starting methods. *TSO 2c.* Interpret the speed torque characteristics of the given single-phase induction motor. *TSO 2d.* Describe the selection procedure of single-phase Induction motors for the given application. *TSO 2e.* Describe the general maintenance procedure of the given single-phase induction motor.	**Unit-2.0 Single Phase Induction Motor** 2.1 Construction and Principle of operation: Double revolving field theory. 2.2 Equivalent circuit. 2.3 Starting of Single-phase Induction Motor: Split phase- Resistance start, capacitor start, capacitor start capacitor run and shaded pole Induction motor with their torque speed characteristics 2.4 Applications of various types of single-phase induction motor. 2.5 Maintenance of different types of single-phase motors, rewinding.	**CO1, CO2**
TSO 3a. Explain the constructional details of a synchronous machine with a neat sketch. TSO 3b. Explain the working principle of an alternator. TSO 3c. Differentiate between turbo and hydro generators. TSO 3d. Describe the effect of armature reaction at different excitation	**Unit-3.0 Alternators** 3.1 Construction- Salient and Cylindrical rotor. 3.2 Rotating magnetic field and working of Alternator (Synchronous generator), Synchronous speed and slip speed 3.3 Equivalent circuit model. 3.4 EMF equation 3.5 Chording factor, breadth factor	**CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3e. Determine voltage regulation of the given alternator by synchronous impedance method. TSO 3f. Interpret the power-angle characteristics of an alternator TSO 3g. Synchronize the given alternator with infinite bus bar or another alternator. TSO 3h. Explain the essential conditions for the parallel operation of two alternators.	3.6 Nature of armature reaction at unity power factor, lagging and leading pf. 3.7 Open circuit and short circuit characteristics. 3.8 Voltage regulation-voltage regulation by synchronous impedance method. 3.9 Operating characteristics- Power angle characteristics, effect of excitation on variable load 3.10 Synchronization and conditions of synchronization. 3.11 Synchronization of alternator with bus bar/alternator- two bright and one dark lamp method, synchroscope method 3.12 Parallel operation of alternators.	
TSO 4a. Explain the working principle of synchronous motor. TSO 4b. Describe the given method(s) of starting of a synchronous motor. TSO 4c. Explain the significance of V and inverted V curves. TSO 4d. Interpret the effect of change in excitation in synchronous motor at constant load. TSO 4e. Explain the phenomenon of hunting in synchronous machine. TSO 4f. Describe the industrial applications of synchronous motor.	**Unit-4.0 Synchronous Motor** 4.1 Working principle, Starting of Synchronous motor. 4.2 Equivalent circuit, Phasor diagram. 4.3 Power angle characteristics. 4.4 Effect of change in excitation at constant load, 'V' and inverted 'V' curves. 4.5 Hunting and its prevention. 4.6 Applications of synchronous motor- synchronous phase modifier, constant speed drives.	**CO3, CO4**
TSO 5a. Explain the construction and working of the given special electrical machine with the help of a neat labelled sketch. TSO 5b. Interpret the speed torque characteristics of the given special motor. TSO 5c. Describe the select procedure of special machine for the given application.	**Unit-5.0 Special Electrical Machines** 5.1 Construction, working and speed-torque characteristics and applications of – **[i]** AC servo motor **[ii]** Stepper motor **[iii]** Linear Induction Motor (LIM) **[iv]** Reluctance motor **[v]** Hysteresis motor [vi] Universal motor 5.2 Criteria for the selection of special motor	**CO4, CO5**

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

A) Course Code : **2420404 (T2420404/P2420404/S2420404)**

B) Course Title : Control System and PLC

C) Pre- requisite Course(s) : Basic engineering Mathematics, Fundamentals of Electronics Engineering

D) Rationale :

The modern industries are moving towards automation, wherein the various parameters such as position, speed is automatically Controlled and also at the same time the stability of the control system is also ensured. This is a branch of technology which applies automatic control theory to design various control systems in such a manner to achieve a desired control of operation of the system. The systems use mathematical modeling in terms of inputs and outputs to study the behaviors of systems. This course will facilitate the students to use different control strategies in various range of applications from simple home refrigeration systems to large industrial control systems. The course also introduces the control through P, PD, PI, PID controller as well as PLC which is widely used for automatically controlling the manufacturing process.

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 Apply the basics of control system to a given system.
CO-2 Analyze time response of the first and second order control systems.
CO-3 Determine the stability of a given control system using Routh-Hurwitz and Bode plot methods.
CO-4 Use PID Controller to initiate control action in a given control system.
CO-5 Use PLC to control the simple industrial 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/ Developmentof 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	3	2	-	-	2		
CO-2	3	2	2	2	-	-	2		
CO-3	3	3	2	2	3	-	2		
CO-4	3	3	3	2	2	-	3		
CO-5	3	2	2	3	2	3	3		

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

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: T2420404

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Classify the given type(s) of control system. *TSO 1b.* Draw block diagrams of different control systems and apply reduction techniques to reduce it. *TSO 1c.* Determine the transfer function of the given control system *TSO 1d.* Identify the poles and zeroes of given control system in s plane with justification. *TSO 1e.* Justify effect of feedback on control system	**Unit-1.0 Basics of Control System** 1.1 Control system -Open and closed loop, linear and nonlinear, time variant and time invariant 1.2 Feedback and its types- Degenerative and Regenerative, effect of feedback on stability and sensitivity. 1.3 Transfer function of R-C and R-L-C electrical circuits 1.4 Pole-Zero plot in S-plane 1.5 block diagram and its reduction techniques: Need and its Significance. 1.6 Control system components – Servomotors -AC and DC, Stepper motor, Error Detector- Potentiometer and Synchro, Feedback Element-Optical encoder -Incremental and absolute - Construction, working, speed torque characteristics and applications	**CO1**
TSO 2a. Explain transient and steady state time response of a given control system *TSO 2b.* Explain various standard test input signals step, ramp, parabolic and impulse signals applicable to a given control system. *TSO 2c.* Determine transfer function of a first order and second order system for a given input *TSO 2d.* Analyze first and second order system time response with unit step input signal *TSO 2e.* Solve simple numericals based on first and second order system *TSO 2f.* Define different time response specifications	**Unit-2.0 Time Response Analysis** 2.1 Time Response: Transient and steady state response 2.2 Standard Test Inputs: step, ramp, parabolic and Impulse inputs and their Laplace Transform and their graphical representation 2.3 Order and type of system with standard equations and examples 2.4 First order control system: Analysis for unit step input, concept of time constant 2.5 Second order control system: Analysis for unit step input (derivation not required), concept, effect of damping 2.6 Time Response Specifications: Rise time, Delay time, Peak time, Settling time, Peak overshoot, steady state errors (no derivations) and simple numericals 2.7 Steady state analysis: Type 0,1,2 systems steady state error and Steady state error constants and simple numericals	**CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Explain the conditions for the stability of a given control system. *TSO 3b.* Determine the stability of a given control system using Routh's stability criteria. *TSO 3c.* Analyze stability of system using Routh's stability criteria *TSO 3d.* Explain necessary and sufficient conditions for stability *TSO 3e.* Explain frequency response specifications of the given control system. *TSO 3f.* Determine the stability of the given control system using Bode plot.	**Unit-3.0 Stability Analysis** 3.1 Concept of stability, root locations in s-plane and analysis, Stable, unstable, critically and conditionally stable system, Absolute and relative stability 3.2 Routh's stability criterion: Steps and procedures to find stability by Routh's stability criteria, numerical problems 3.3 Routh - Hurwitz polynomials, Necessary and sufficient conditions for stability 3.4 Frequency Response Analysis method: Concept, Advantages and Disadvantages, Frequency response specifications. 3.5 Bode Plot: Need, Magnitude plot and phase angle plot, Bode plot for gain K, poles and zeros at origin, and 1st order system, 3.6 Analysis of stability from Bode plot using Gain margin and Phase margin	**CO3**
TSO 4a. Explain the given process control system with the help of a block diagram *TSO 4b.* Describe the discontinuous control actions used for controlling the given process control system with a neat sketch. *TSO 4c.* Describe the basic continuous control actions used for controlling the given process control system using neat sketch. *TSO 4d.* Describe the composite continuous control actions used for controlling the given process control system. *TSO 4e.* Identify relevant control action(s) for the given process control system with justification and neat sketches	**Unit-4.0 Process Controllers Dynamics** 4.1 Process Control System: Block diagram, functions of each block 4.2 Control Actions i. Discontinuous Mode: ON-OFF controllers equations and neutral zone ii. Continuous Mode: Proportional, Integral and Derivative Controllers- output equation, response and characteristics 4.3 Composite Controllers: PI, PD and PID Controllers- Operation, output equations, response graph, comparison and applications	**CO4**
TSO 5a. Describe the working of a simple given industrial automation system along with a block diagram. *TSO 5b.* Describe the working of each building block of a simple given PLC system using block diagram. *TSO 5c.* Describe the steps to interface the input analog and digital devices to given PLC. *TSO 5d.* Describe the steps to interface the output analog and digital devices to given PLC. *TSO 5e.* Describe the program scan cycle of a given PLC. *TSO 5f.* List the advantages and applications of a given PLC. *TSO 5g.* Explain the steps for PLC installation	**Unit-5.0 Basics of PLC** 5.1 Definition of industrial automation, block diagram, working of each building block 5.2 PLC- Definition, Block diagram Parts of PLC, Principles of Operation, functions of various blocks, 5.3 Input and output modules- : analog & digital, I/O Specifications 5.4 Classification (fixed and modular PLCs) 5.5 PLC Scan cycle and speed of execution 5.6 Advantages and applications of PLC 5.7 PLC installation	**CO5**

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

A) Course Code : **2420405 (P2420405/S2420405)**

B) Course Title : Electrical Software Lab

C) Pre- requisite Course(s) : Engg. Mathematics, Electrical Circuits and networks, Fundamentals of IT and C Programming

D) Rationale :

All electrical and electronic systems in industrial sector are designed based on drawings. Therefore, Electrical Drawing is used starting from designing, manufacturing, testing, till installation, commissioning and even for maintenance. A technician working in design and shop floor must possess skills of reading and interpreting of electrical engineering drawing. With the evolution of various computer software, the role of the earlier draftsman is now taken over by computer software. The AutoCAD software is widely used for drawing.

Due to revolution in ICT, the industries are switching to different Electronics Design and Automation (EDA)/ simulation tools to design, simulate various electrical/electronic circuits, test, analyze and interpret the results and graphs. Diploma pass outs are required to be competent in working with simulation tools particularly MATLAB/Simulink which not only provide facilities to choose amongst wide range of devices and components but also test and analyze the performance of an Electrical/Electronic circuit prior to its physical implementation thus reducing the cost, time and damage for hardware implementation by optimizing the circuit performance. Because of this the task of professionals in designing and analyzing circuits has become comparatively stress free. Hence this course is designed in such a way that the practical experiences will enable the diploma student to become competent not only in using the AutoCAD software but also become competent in using MATLAB/Simulink to simulate electrical/electronic circuits.

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

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

CO-1 Use standard symbols and codes for representing electrical and electronic components.
CO-2 Use Auto CAD software for the 2D view of an electrical component.
CO-3 Perform various arithmetic operations and plot different types of plots using MATLAB.
CO-4 Interpret the results of various electric and electronic circuits developed using MATLAB.
CO-5 Interpret the simulated model of electrical/electronic circuits developed using Simulink.

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/ Developmentof 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	2	-	-	2		
CO-2	3	2	3	3	1	1	2		
CO-3	3	2	3	3	-	1	2		
CO-4	3	2	3	3	1	1	2		
CO-5	3	2	3	3	1	1	2		

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

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:

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1.a Identify the given types of electrical and electronic components based on symbols. TSO 1.b Draw free hand sketch for a given substation. TSO 1.c Draw the layout of the installation of electrical appliance and their wiring diagram for the given residential house. TSO 1.d Draw Electrical substation earthing layout as per IS standards.	**Unit-1.0 Symbols and Codes** 1.1 ISI Symbols in electrical engineering 1.2 Conventions for circuit and schematic representation of electrical and electronic components, instruments, and equipment 1.3 Substation layout with circuit breaker, on-load and off-load isolators, Buchholz's relay, and other protective devices of transformers 1.4 Plate and Pipe Earthing	**CO1**
TSO 2.a Prepare Computer-Aided Drawing using Auto CAD. TSO 2.b Prepare cross sectional view of a given electrical machine using Auto CAD. TSO 2.c Draw the orthogonal projection of the given type of insulators using Auto CAD.	**Unit-2.0 Computer Aided Electrical Drawing (CAD)** 2.1 Computer-Aided Drawing: Draw command, edit command, Coordinate entry, Osnap, Layers, Dimensioning, Text in a drawing, Ortho command, Zoom T command, and plot command 2.2 General electrical and electronic symbols, Layouts of domestic, commercial, and industrial wiring (2D only) 2.3 Cross-Sectional view of: • Fuse and cables (2D) • D.C. Motor and their parts • Single-phase Transformer • Power transformer • Induction Motor • Insulators, Circuit Breakers, Lightning arresters	**CO1, CO2**
TSO 3.a List the major components of MATLAB environment. TSO 3.b Explain with an example the basic arithmetic operations on matrices and Arrays. TSO 3.c Perform functions and operations using variables and arrays to learn about relational and logical operators. TSO 3.d Access different features such as creating M-File, save M-File of MATLAB.	**Unit-3.0 MATLAB Environment** 3.1 Introduction: Features, applications, and software versions 3.2 Getting started MATLAB: Using it as a calculator, creating variables, Overwriting variables, Error messages, and Making corrections 3.3 M-File Script; Examples, Script side-effects M-File Functions; Anatomy of a M-File function, Input and output arguments,	**CO3**

Major Theory Session Outcomes (TSOs)		Units	Relevant COs Number(s)
TSO 3.e	Perform basic operation on matrices such as addition, subtraction, multiplication with simple examples	3.4 Controlling the hierarchy of operations or precedence, Controlling the appearance of floating-point numbers, 3.5 Managing the Workspace 4.1 Matrices and Operators: Introduction, the Colon Operator, Accessing Parts of a Matrix, Combining and Transforming Matrices, Matrix Building, Input-output, Plotting, Debugging. 3.6 Functions: Introduction, Function I/O, Formal Definition of Functions, Subfunctions, Scope, Advantages of Functions, Scripts, and Problem Solving 3.7 Plotting: Creating simple plots, adding titles, axis labels, and annotations, Multiple data sets in one plot, specifying line styles and colors, Copy/Paste Figures, Saving Figures	
TSO 3.f	Use functions in MATLAB in different applications of mathematical operation.		
TSO 3.g	Describe the procedural steps to plot various graphs as per given condition.		
TSO 4.a	Perform functions and operations using variables and arrays to learn about relational and logical operators.	**Unit-4.0 MATLAB Programmer's Toolbox** 4.2 If-Statements, Relational and Logical Operators 4.3 Nested If-Statements 4.4 Variable Number of Function Arguments, Robustness 4.5 Persistent Variables 4.6 For-Loops, While - Loops 4.7 Break Statements, Logical Indexing 4.8 Data Types: Strings, Structs, Cells 4.9 Applications of MATLAB in • Electrical circuits and networks • Electrical Machine • Power system • Control system and • Power Electronics	**CO3, CO4**
TSO 4.b	Write MATLAB program using If statements.		
TSO 4.c	Write MATLAB program using For-loop statements.		
TSO 4.d	Write MATLAB program using For and While loop statements.		
TSO 4.e	Write MATLAB program to plot the various performance characteristics of for 3-phase Induction motor.		
TSO 4.f	Write MATLAB program to plot the various waveforms for power converters.		
TSO 4.g	Write MATLAB program to plot pole zero pattern for a given transfer function.		
TSO 4.h	Write a MATLAB program to determine fault current for a given power system network.		
TSO 5.a	Use Simulink to plot the transient analysis of RLC, RL and RC circuits for sinusoidal and step inputs.	**Unit-5.0 Simulink** 5.1 Getting Started with Simulink 5.2 Simulink Library Browser 5.3 Connections 5.4 Block Specification 5.5 Toolboxes 5.6 Building Systems 5.7 Applications of Simulink to • Electrical Circuits and networks • Electrical Machine • Power system • Control system and • Power Electronics	**CO4, CO5**
TSO 5.b	Use Simulink to verify Superposition theorem, Thevenin's theorem, Norton's theorem and Maximum power Transfer theorem, analyze and interpret the results		
TSO 5.c	Use Simulink to plot the various performance characteristics of for 3-phase Induction motor.		
TSO 5.d	Use Simulink to plot pole zero pattern for a given Transfer Function.		
TSO 5.e	Use Simulink to plot the various waveforms for power converters.		
TSO 5.f	Use Simulink to perform fault analysis for a given power system network.		

A) Course Code : **2400107(T2400107)**

B) Course Title : Professional Ethics (Non-Exam Course)
(CE, CSE, ELX, ELX (R), FTS, ME, ME (Auto), AIML, MIE, CHE, CRE, FPP, GT)

C) Pre- requisite Course(s) : General awareness about moral values and different workplaces

D) Rationale :

One of the programme outcomes of the diploma course incorporates ethical practices in application of appropriate technology in context of society, sustainability, environment. It is of great importance to distinguish between the terms values and ethics. Ethics are norms of behaviour that are set by authorities at workplace. The persons belonging to that workplace are expected to follow the norms. Ethical behaviour at workplace affects the person's relation to people, creates a positive impact on business processes and environment. It is very important that a person has not only understanding of ethical behavior but also the responsibility to set ethical practices in own area of work.

While values are personal preferences or choices, they may sometimes contradict with ethics at his workplace. The values of a person affect behavior and his decision making.

This course is meant to sensitize the student to ethics in profession and motivate them to demonstrate ethical behavior in day to day activities and be aware of ethics in profession.

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 Demonstrate good values and ethics in the day to day activities and at workplace.

CO-2 Identify a set of values and ethics related to fair professional practice.

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/ Developmentof 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	3	3	3	3	3		
CO-2	3	3	3	3	3	3	3		
CO-3	3	3	3	3	3	3	3		

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:

Board Of Study	Course Code	Course Title	Scheme of Study (Hours/Week)				
			Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
			L	T			
	2400107	Professional Ethics	01	-	-	01	01

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

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 List 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

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: 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.
4. Group discussions on current print articles.
   - Adoption of Article 365 in India.
   - Need of amendments in the constitution.

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:

Board of Study	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	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.

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