

Curriculum of Diploma Programme
in
Agricultural Engineering



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

**State Board of Technical Education
(SBTE), Bihar**

Semester – IV Teaching & Learning Scheme

Course Codes	Category of course	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				
2411401	PCC	Farm Power and Engine	03	-	04	02	09	06
2425402	PCC	Fluid Mechanics & Hydraulic Machinery	03	-	04	02	09	06
2411403	PCC	Plant Genetics and Nursery Technology	03	-	04	02	09	06
2411404	PCC	Water Resources Management and Pumps	03	-	04	02	09	06
2411405	PCC	Soil and Water Conservation	02	01	-	02	05	04
2400007	NRC	Indian Constitution (Common for All Programmes)	01	-	-	-	01	01
2400107	NRC	Professional Ethics	01	-	-	-	01	01
Total			16	1	16	10	43	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. 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.

Semester - IV Assessment Scheme

Course Codes	Category of course	Course Titles	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)	
2411401	PCC	Farm Power and Engine	30	70	20	30	20	30	200
2425402	PCC	Fluid Mechanics & Hydraulic Machinery	30	70	20	30	20	30	200
2411403	PCC	Plant Genetics and Nursery Technology	30	70	20	30	20	30	200
2411404	PCC	Water Resources Management and Pumps	30	70	20	30	20	30	200
2411405	PCC	Soil and Water Conservation	30	70	20	30	-	-	150
2400007	NRC	Indian Constitution (Common for All Programmes)	25	-	-	-	-	-	25
2400107	NRC	Professional Ethics	25	-	-	-	-	-	25
Total			200	350	100	150	80	120	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 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.

- A) **Course Code** : 2411401(T2411401/P2411401/S2411401)
 B) **Course Title** : Farm Power & Engine
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Farm Power is an essential input in agriculture for timely field operations for increasing production and productivity of land. Farm power is used for operating different types of machinery like tillage, planting, plant protection, harvesting and threshing machinery and other stationary jobs like operating irrigation equipment, threshers/ shellers/ cleaners/ graders, etc. This course is designed for a diploma holder technician in Agricultural Engineering to make them understand about the operations control, maintenance and repairing of different sources of power used in agricultural sector. They should know about the proper utilization of agricultural machinery, processing equipment's in agricultural FARM and FIRM with safety for stationary & mobile engines.

- 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 farm power as per the given situation.
CO-2 Evaluate the performance of farm machinery under actual field conditions.
CO-3 Select the different systems of combustion engine as per the given situation
CO-4 Analyze the performance of the tractor
CO-5 Select Tractor and power tiller as per the requirement.

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

- 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				
2411401	Farm Power and Engine	03	-	04	02	09	06

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)	
2411401	Farm Power and Engine	30	70	20	30	20	30	200

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: T2411401

Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.1a</i> Use farm power as per the given situation</p> <p><i>TSO.1b</i> Select conventional and non-conventional energy sources for farm power for the given situation.</p> <p><i>TSO.1c</i> Apply farm mechanization techniques to mechanize the traditional farms.</p> <p><i>TSO.1d</i> Resolve the challenges in farm mechanization.</p> <p><i>TSO.1e</i> Describe the procedure to enhances productivity for the given situation</p>	<p>Unit-1.0 Introduction to Farm Power and Energy Sources</p> <p>1.1 Status of farm power in India, sources of farm power</p> <p>1.2 Energy for agriculture- human power, animal power, mechanical power, electrical power, renewable energy</p> <p>1.3 Usage of renewable energy sources</p> <ul style="list-style-type: none"> • Solar energy- solar dryers, lantern, cooker, solar still, solar refrigeration, solar lighting • Wind energy- water pumping, electricity generation • Biomass energy- gasifiers to produce producer gas, pyrolysis to produce liquid fuels, biogas • Tidal energy – electricity generation • Geothermal energy- heat and electricity production <p>1.4 Force, work, power and energy, conversion factors</p> <p>1.5 Concept of farm mechanization, scope of farm mechanization, benefits of farm mechanization, Constraints in farm mechanization in Indian condition.</p> <p>1.6 Merit and demerits of different farm power sources.</p>	CO1
<p><i>TSO.2a</i> Describe the principle of given thermodynamic cycle in IC engine.</p> <p><i>TSO.2b</i> Explain the construction and working of the given IC engine</p> <p><i>TSO.2c</i> Analyze the operation of two stroke and four stroke engines.</p> <p><i>TSO.2d</i> Analyze valve arrangement function of IC engine</p> <p><i>TSO.2e</i> Calculate horse power, brake horse power, indicated horse power.</p> <p><i>TSO.2f</i> Calculate the tractor engine power, torque, fuel consumption, draft and drawbar power</p>	<p>Unit-2.0 Combustion Engine</p> <p>2.1 Classification of heat engines- based on combustion of fuel, based on fuel used, based ignition of fuel, based on working cycle</p> <p>2.2 Principals of Otto cycle, diesel cycle, theoretical and actual cycle of engine working.</p> <p>2.3 Construction and working principle of I.C. Engine, four stroke cycle engine, two stroke cycle engines</p> <p>2.4 Working principle of diesel engine and petrol engine, Terminology connected with engine power,</p> <p>2.5 Valve arrangement function and valve timing diagram</p> <p>2.6 Measurement of tractor engine power, torque, fuel consumption, draft and drawbar power</p>	CO2
<p><i>TSO.3.a</i> Select lubrication system for the given situation</p> <p><i>TSO.3.b</i> Select lubricants as per requirement</p> <p><i>TSO.3.c</i> Select ignition system for the given situation</p> <p><i>TSO.3.d</i> Select cooling system as pert he given situation.</p>	<p>Unit-3.0 Systems of Combustion Engine</p> <p>3.1 Different systems used for efficient functioning of an engine -fuel supply system, lubrication system, ignition system, cooling system, fuel system, governor, power transmission system</p> <p>3.2 Lubrication system- purpose of lubrication, types of lubricants, properties of good lubricant</p> <p>3.3 Types of lubricating systems- engine lubrication system, splash system, forced feed system, parts of lubrication system, care and maintenance of lubrication system</p> <p>3.4 Ignition system -types of ignition systems-ignition by electric spark or spark ignition, ignition by heat of compression or compression ignition, ignition by hot tub or hot bulb, ignition by open fire, comparison between compression ignition engine and petrol ignition engine</p> <p>3.5 Cooling system- need and purpose of cooling, air</p>	CO3

Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	cooled system and water-cooled system, principle of air cooling, advantage and disadvantage of air-cooled system 3.6 Water cooling system - open jacket or hopper method, thermo siphon method, forced circulation method, pressurized cooling, different parts of the cooling systems, care and maintenance of cooling system	
<p><i>TSO.4a</i> Explain the construction and working of the clutch, transmission gears and steering systems.</p> <p><i>TSO.4b</i> Explain the construction and working of the given fuel injection pump, turbochargers & superchargers</p> <p><i>TSO.4c</i> Analysis of different type of fuel injection system of IC engine.</p> <p><i>TSO.4d</i> Determine the properties of the given fuel</p> <p><i>TSO.4e</i> Select fuel for the given situation.</p> <p><i>TSO.4f</i> Calculate the performance of the tractor</p> <p><i>TSO.4g</i> Evaluate the result of performance testing</p> <p><i>TSO.4h</i> Identify the fuel line and air supply line in the given tractor.</p> <p><i>TSO.4i</i> Select governing system used in engine.</p> <p><i>TSO.4j</i> Explain governor hunting and governor regulation.</p>	<p>Unit 4.0 Power Transmission System and Engine Fuel System</p> <p>4.1 Functions of power transmission system, construction and working of Clutch and fluid coupling clutch, necessity of clutch in a tractor, essential features of a good clutch, Types of clutch- (1) friction clutch (2) dog clutch (3) fluid coupling.</p> <p>4.2 Construction and working transmission gears and torque converter gear, Differential unit and final drive</p> <p>4.3 Construction and working Steering system and brake steering system</p> <p>4.4 Tractor hitch, Power take-off unit, Belt pulley</p> <p>4.5 Engine and tractor performance testing, evaluation and interpretation of results.</p> <p>4.6 Introduction to Fuel line & air supply, Fuel supply system in spark ignition engine and diesel engine</p> <p>4.7 Turbochargers & superchargers, Fuel injection pump & nozzles, Carburetor</p> <p>4.8 Fuel properties, Engine detonation</p> <p>4.9 Governor – principle and function of governor, types of governors- centrifugal governor, pneumatic governor, hydraulic governor</p> <p>4.10 Governor regulation, governor hunting</p>	CO4
<p><i>TSO.5.a</i> Describe the procedure of operating the given tractor and tiller</p> <p><i>TSO.5.b</i> Select tractor and tiller as per the requirement</p> <p><i>TSO.5.c</i> Identify the different controls on the control board</p> <p><i>TSO.5.d</i> Describe the safety precautions before starting of the given tractor</p> <p><i>TSO.5.e</i> Describe the procedure of starting and stopping the given tractor or tiller</p> <p><i>TSO.5.f</i> Identify the different components of tractor and power tiller</p> <p><i>TSO.5.g</i> Select the tyres for the given tractor and tiller</p> <p><i>TSO.5.h</i> Describe the procedure to maintain and troubleshoot the given tractor and tillers</p> <p><i>TSO.5.i</i> Estimate the cost of operating given tractor and tillers.</p>	<p>Unit 5.0 Tractors and power Tillers</p> <p>5.1 Classification of tractor, Technical specifications of tractors available in India, modern trends in tractor design and development, special design features of tractors in relation to Indian agriculture, components of a tractor</p> <p>5.2 Parameters affecting design of tractor engine and their selection.</p> <p>5.3 Recent trends in tractor design, Control board or dash board of a tractor, emissions and control of pollutants</p> <p>5.4 Method of starting and stopping a diesel tractor and precautions to be taken</p> <p>5.5 Power tiller, components of power tiller, Transmission of power in a power tiller, Tractor tyres and front axle</p> <p>5.6 Maintenance and troubleshooting of farm tractors and tillers</p> <p>5.7 Costing of farm power machineries</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2411401

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO 1.1. Use wind turbine test rig	1.	Measure the power generated by a wind turbine.	CO1
	2.	Determine the relationship between wind turbine blade pitch and power generated.	CO1
	3.	Measure current, potential difference (voltage), and power output of a wind turbine with a vernier energy sensor.	CO1
	4.	Use electrical energy produced by a small wind turbine to play a tune and light up LED.	CO1
LSO 1.2. Use solar energy test rig	5.	Use electrical energy produced by a solar panel to play a tune and light up LED.	CO1
	6.	Investigate the relationship between solar panel angle, orientation, and shade and the ability to play a tune or light up an LED.	CO1
	7.	Measure current, potential difference (voltage), and power output of a solar panel with a vernier energy sensor.	CO1
	8.	Measure the power output of one, two, and three solar panels with an energy sensor	CO1
LSO 2.1. Use working model of the petrol and diesel engine	9.	Identify different stationary, reciprocating and rotating parts of engine	CO2
	10.	Identify the location of various engine subassemblies/ components of the given engine.	CO2
LSO 2.2. Use four stroke SI and CI engine	11.	Determine indicated and brake thermal efficiency, specific fuel consumption at different loads, energy balance of four stroke SI engine	CO2
	12.	Determine indicated and brake thermal efficiency, specific fuel consumption at different loads, energy balance of four stroke CI engine	CO2
LSO 2.3. Use multi cylinder water cooled petrol engine.	13.	Perform "morse test" on a multi cylinder petrol engine at different speed	CO2
	14.	Determine indicated power, break Power and frictional power of given engine at different speed	CO2
	15.	Determine the mechanical efficiency of the engine multi cylinder petrol engine	CO2
LSO 2.4. Use four stroke single cylinder water cooled diesel and petrol engine	16.	Determine the actual valve timing and firing orders of 4-stroke diesel engine.	CO2
	17.	Determine the actual valve timing and firing orders of 4-stroke petrol engine.	CO2
	18.	Perform load test on single cylinder four stroke diesel engine (with rope brake dynamometer and electrical brake dynamometer	CO2
	19.	Perform load test on single cylinder four stroke petrol engine	CO2
	20.	Dismantling and assembling of given petrol Engine / diesel Engine	CO2
LSO 2.5. Use brake test rig	21.	Dismantle and assemble the components of the given brake system	CO2
LSO 3.1. Use tractor and power tiller	22.	Identify different components of lubrication system, ignition system, cooling system, tractor differential of the	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
		given tractor or power tiller	
	23.	Dismantle and assemble the given oil filter, fuel filter, fuel injection system and carburetor.	CO3
	24.	Trace ignition system of the given engine	CO3
	25.	Check engine cooling system of the tractor	CO3
	26.	Test thermostat valve and electric cooling fan thermo switch.	CO3
	27.	Replace / replenish coolant of an engine after checking.	CO3
	28.	Check lubrication system of the given engine	CO3
	29.	Change oil and oil filter	CO3
	30.	Disassemble lubrication system, ignition system and cooling system of the given tractor	CO3
	31.	Assemble lubrication system, ignition system and cooling system of the given tractor.	CO3
LSO 3.2. Use tractor transmission test rig	32.	Test the performance of axle transmission	CO3
LSO 4.1. Use injector testing machine	33.	Test the pressure of the fuel when the injector nozzle starts spraying	CO4
	34.	Perform the leak off test of injector	CO4
	35.	Perform the spray test on injector testing machine	CO4
	36.	Calibrate and adjust injection timing of fuel injection pump	CO4
LSO 4.2. Use Fuel Supply System test rig	37.	Trace fuel supply system of the given engine	CO4
LSO 4.3. Use cleveland apparatus	38.	Determination of flash point (open) and fire point of the sample oil by means of the cleveland apparatus.	CO4
LSO 4.4. Use bomb calorimeter	39.	Determination of calorific value of given fuel by bomb calorimeter.	CO4
LSO 4.5. Use redwood viscometer	40.	Determine the viscosity of the given oil at various temperatures and plot the variation of viscosity with temperature.	CO4
LSO 4.6. Dismantle and assemble different components of tractor and power tiller	41.	Dismantle and assemble single plate dry type clutch assembly	CO4
	42.	Dismantle and assemble gear box	CO4
	43.	Identify the components of the sequential automatic transmission	CO4
	44.	Dismantle and assemble propeller shaft-Universal joint assembly	CO4
	45.	Dismantle and assemble carburetor	CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
	46.		
	47.	Dismantle and assemble brake system	CO4
LSO 5.1. Operate tractor and power tiller	48.	Identify the different parts of given type of Power tiller and tractor	CO5
	49.	Identify the safety devices used in the given vehicle	CO5
	50.	Read different indicators on the dashboard	CO5
	51.	Operate different levers and switches present on the dashboard	CO5
	52.	Operate different systems in the given type of power tiller and tractor	CO5
	53.	Practice starting and stopping of the tractor	CO5
	54.	Drive tractor and power tiller with and without implements	CO5
	55.	Practice tractor driving in certain limited area like L shape, S-shape, Circle, 8-shape etc	CO5

L) Suggested Term Work and Self Learning: S2411401 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Visit a nearby tractor workshop and prepare a report on the trouble shooting and servicing of different components
- ii. Comparison of two stroke and four stroke cycle engines
- iii. Prepare report on the constructional details, working principles and operation of the following automotive clutches:
 - a. coil – spring clutch
 - b. diaphragm spring clutch
 - c. double disk clutch
- iv. Prepare report on the constructional details, working principles and operation of the following automotive brake systems:
 - a. Hydraulic & pneumatic brake system
 - b. Drum brake system
 - c. Disk brake system
 - d. Antilock brake system

b. Micro Projects:

- i. Collect the data on various type engines used in power tillers and compare on the basis of criteria like their fuel efficiency, maintenance cycle etc and prepare the report.
- ii. Collect the data of any three types of tractors used for agricultural purpose and compare them on the basis of given criteria
- iii. Visit nearby dealers of tractors and power tillers and collect data on the advance system used in power tillers and tractors and prepare the report
- iv. Develop a cut section models of transmission system or any other components.
- v. Prepare a maintenance and trouble shooting charts for the various components and engine of tractor and power tiller

c. Other Activities:

- Visit to nearby workshop and prepare a report on the procedure of assembly and disassembly of engine of the tractor and safety precautions to be taken.
- Prepare display boards or charts for clutch, gear box, propeller shaft and universal joints, differential and types of rear axle, wheels and tyres etc.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	30%	10%	25%	-	10%	20%
CO-3	15%	20%	15%	25%	33%	15%	20%
CO-4	30%	20%	30%	25%	33%	15%	20%
CO-5	30%	15%	30%	25%	34%	40%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit 1.0 Introduction to Farm Power and Energy Sources	8	CO1	12	3	4	5
Unit 2.0 Combustion Engine	12	CO2	16	5	5	6
Unit 3.0 Systems of Combustion Engine	10	CO3	15	4	5	6
Unit 4.0 Power Transmission System and Engine Fuel System	10	CO4	15	4	5	6
Unit 5.0 Tractors and Power Tillers	8	CO5	12	4	3	5
Total	48	-	70	20	22	28

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance PRA * (%)	PDA ** (%)	Viva-Voce (%)
1.	Measure the power generated by a wind turbine.	CO1	50	40	10
2.	Determine the relationship between wind turbine blade pitch and power generated.	CO1	50	40	10
3.	Measure current, potential difference (voltage), and power output of a wind turbine with a vernier energy sensor.	CO1	50	40	10
4.	Use electrical energy produced by a small wind turbine to play a tune and light up LED.	CO1	50	40	10
5.	Use electrical energy produced by a solar panel to play a tune and light up LED.	CO1	50	40	10
6.	Investigate the relationship between solar panel angle, orientation, and shade and the ability to play a tune or light up an LED.	CO1	50	40	10
7.	Measure current, potential difference (voltage), and power output of a solar panel with a vernier energy sensor.	CO1	50	40	10
8.	Measure the power output of one, two, and three solar panels with an energy sensor	CO1	50	40	10
9.	Identify different stationary, reciprocating and rotating parts of engine	CO2	50	40	10
10.	Identify the location of various engine subassemblies/ components of the given engine.	CO2	50	40	10
11.	Determine indicated and brake thermal efficiency, specific fuel consumption at different loads, energy balance of four stroke SI engine	CO2	50	40	10
12.	Determine indicated and brake thermal efficiency, specific fuel consumption at different loads, energy balance of four stroke CI engine	CO2	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA * (%)	PDA ** (%)	
13.	Perform "morse test" on a multi cylinder petrol engine at different speed	CO2	50	40	10
14.	Determine indicated power, break power and frictional power of given engine at different speed	CO2	50	40	10
15.	Determine the mechanical efficiency of the engine multi cylinder petrol engine	CO2	50	40	10
16.	Determine the actual valve timing and firing orders of 4-stroke diesel engine.	CO2	50	40	10
17.	Determine the actual valve timing and firing orders of 4-stroke petrol engine.	CO2	50	40	10
18.	Perform load test on single cylinder four stroke diesel engine (with rope brake dynamometer and electrical brake dynamometer	CO2	50	40	10
19.	Perform load test on single cylinder four stroke petrol engine	CO2	50	40	10
20.	Dismantling and assembling of given petrol Engine / diesel Engine	CO2	50	40	10
21.	Dismantle and assemble the components of the given brake system	CO2	50	40	10
22.	Identify different components of lubrication system, ignition system, cooling system of the given tractor or power tiller	CO3	50	40	10
23.	Dismantle and assemble the given oil filter, fuel filter, fuel injection system and carburetor.	CO3	50	40	10
24.	Trace ignition system of the given engine	CO3	50	40	10
25.	Check engine cooling system of the tractor	CO3	50	40	10
26.	Test thermostat valve and electric cooling fan thermo switch.	CO3	50	40	10
27.	Replace / replenish coolant of an engine after checking.	CO3	50	40	10
28.	Check lubrication system of the given engine	CO3	50	40	10
29.	Change oil and oil filter	CO3	50	40	10
30.	Disassemble lubrication system, ignition system and cooling system of the given tractor	CO3	50	40	10
31.	Assemble lubrication system, ignition system and cooling system of the given tractor.	CO3	50	40	10
32.	Test the performance of axle transmission	CO3	50	40	10
33.	Test the pressure of the fuel when the injector nozzle starts spraying	CO4	50	40	10
34.	Perform the leak off test of injector	CO4	50	40	10
35.	Perform the spray test on injector testing machine	CO4	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA * (%)	PDA ** (%)	
36.	Calibrate and adjust injection timing of fuel injection pump	CO4	50	40	10
37.	Trace fuel supply system of the given engine	CO4	50	40	10
38.	Determination of flash point (open) and fire point of the sample oil by means of the cleveland apparatus.	CO4	50	40	10
39.	Determination of calorific value of given fuel by bomb calorimeter.	CO4	50	40	10
40.	Determine the viscosity of the given oil at various temperatures and plot the variation of viscosity with temperature.	CO4	50	40	10
41.	Dismantle and assemble single plate dry type clutch assembly	CO4	50	40	10
42.	Dismantle and assemble gear box	CO4	50	40	10
43.	Identify the components of the sequential automatic transmission	CO4	50	40	10
44.	Dismantle and assemble propeller shaft-Universal joint assembly	CO4	50	40	10
45.	Dismantle and assemble carburetor	CO4	50	40	10
46.	Dismantle and assemble brake system	CO4	50	40	10
47.	Identify the different parts of given type of Power tiller and tractor	CO5	50	40	10
48.	Identify the safety devices used in the given vehicle	CO5	50	40	10
49.	Read different indicators on the dashboard	CO5	50	40	10
50.	Operate different levers and switches present on the dashboard	CO5	50	40	10
51.	Operate different systems in the given type of power tiller and tractor	CO5	50	40	10
52.	Practice starting and stopping of the tractor	CO5	50	40	10
53.	Drive tractor and power tiller with and without implements	CO5	50	40	10
54.	Practice tractor driving in certain limited area like L shape, S-shape, Circle, 8-shape etc	CO5	50	40	10

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Visit to commercial Nurseries /Agricultural Universities /KVK.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Wind Turbine with Blade Design	Height: approx. 12 in, Maximum blade diameter: 10 in (Mini Turbine), 16 in. (with blade design option), Expected power output: 0-2 watts	1-4
2.	Wind Sound and Light Board	Simple power output board to demonstrate power output from small electrical devices. board needs at least 2 V to start working.	4
3.	Solar Energy Kit	Box dimensions: Approx. 13 1/8 in x 7 5/8 in x 4 1/2 in Maximum power output: 1.2 to 2W (6 V x 200 mA in series, or 2 V x 600 mA in parallel)	5-8
4.	Vernier Energy Sensor	Source Input Potential Range: ± 30 V Source Input Current Range: ± 1000 mA	6-8
5.	Piston Kit	Piston kit	9
6.	Crankshaft	Crushing Capacity: 50 -60 Ton/hr, Size: approx. 36x24 inch Speed – 280-300 rpm, Surface treatment mirror polished	9
7.	Inlet & Exhaust Manifold	Engines materials -SS, polished, Power Range- 336-664 kw	9
8.	Flywheel	Flywheel Assembly material – Mild Steel, Diameter- 380-400 mm, Thickness = 10-15 mm	9
9.	Spark Plug	Material – Stainless Steel, Fuel type - CGN/Petrol /LPG Normal voltage - 12V	9
10.	Radiator	Material- Aluminum, capacity - 200 – 300-liter, Tube Type - Seamless, orientation – Downflow, core material - Copper or Aluminum.	9
11.	PC Based Petrol Engine Test Rig	Petrol Engine, single cylinder or multi cylinder, Dynamometer-Regenerative type, Eddy current type, Hydraulic type, AC Alternator, DC Generator, Rope-brake type , Temperature sensors, Fuel Consumption Measuring Unit, Air flow rate measuring sensor, transmitter Engine speed (rpm) sensor, transmitter Torque/Load sensor, transmitter Cooling water flow rate sensor transmitter, Engine indication system consisting of a Piezo Sensor, Crank Angle marker and necessary software, Data Interface Module, Software with single or multi user license, Control Panel, Exhaust gas calorimeter, Water supply arrangement, Battery, Battery charger, Computer	9-20
12.	PC Based Diesel Engine Test Rig	Diesel Engine, single cylinder or multi cylinder, Dynamometer-Regenerative type, Eddy current type, Hydraulic type, AC Alternator, DC Generator, Rope-brake type , Temperature sensors, Fuel Consumption Measuring Unit, Air flow rate measuring sensor, transmitter Engine speed (rpm) sensor, transmitter Torque/Load sensor, transmitter Cooling water flow rate sensor transmitter, Engine indication system consisting of a Piezo Sensor, Crank Angle marker and necessary software, Data Interface Module, Software with single or multi user license, Control Panel, Exhaust gas calorimeter, Water supply arrangement, Battery, Battery charger, Computer	9-12, 16-20
13.	Sectional Working Model of 4 Strokes Petrol Engine	Model parts should be of aluminum alloy and metal, sectioned Carburetor and fuel supply with a crank handle, Mounted on base, with printed diagram and Ignition	9-20

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
14.	Sectional Working Model of 4 Strokes Diesel Engine	sectioned Fuel supply with crank handle for operation, Fitted on a base with printed diagram and Ignition. All parts made in aluminum alloy and metal.	9-12, 16-20
15.	Brake test rig	Test the performance of Vehicle Brakes (2 wheel & 4-wheel drive) high-speed data acquisition system for Brake Test Rig. Features-PX-RT Controller, PID Based Torque & Pressure Control 1000 Samples / Second – Data Acquisition, Parameter Data Entry for Multiple Stops, High Speed FPGA Controller Offline Analysis	21
16.	Tractor Differential Model	The working model of tractor differential. The model should be fitted with mixing machine cut gears and essential parts as rear axle with extra speed reducing gears. Duly mounted on wooden base.	22
17.	Electronic Ignition System	Starter solenoid ignition switch, ignition coil, electronic distributor (motor driven), four plugs necessary connections and power supply, open demonstration unit with on board with original parts	22,23,24,30,31
18.	Lubrication System	Working model of the lubrication system with actual parts assembled on a wooden board.	22,23,28,29,30,31
19.	Cooling System	Working of model of cooling system, actual parts assembled on a wooden board in actual working form.	22,25,26,30,31
20.	Engine Cooling Systems Test Rigs	A closed, or optionally an open working model of engine cooling system, air circuit with the addition of external air for low energy consumption feeds the cooler on the air side with up to 40,000 m ³ /h at +20 °C to +90 °C. The model should integrate the supply modules for charge air, motor oil, gear box oil and coolants, water cooled, electric drive for cooling fans to simulate real operating conditions on high performance coolers.	22,25,26,30,31
21.	Tractor Transmission Test Rig	Material-MS, Number of Phases-3, NI Based Tractor Transmission Control System, PX-RT Controller, PID Based Torque Control 1000V Isolation, Synchronization between Three – 100 KW Drives, Customized User Interface, Offline Analysis	32
22.	Computerized Injector Tester	Ultrasonic Range-1-15 Min, Timing Range-1-30 Min Flow Test Accuracy-2%, Input Power-350 W, Pressure-0-7 Bar, Power Supply-AC 220V, 50/60 Hz	33,34,35,36
23.	Fuel Supply System test rig	Fuel Supply System of 06 Cylinder in Line Diesel Engine, consisting of Diesel Tank. Filter Fuel, Injector Pump and fuel injectors. Compete on board motor driven.	37
24.	Fuel Supply System of a Petrol Engine	Consist of Petrol Tank, Fuel Pump, Filter, Carburetor, Complete on 60x30 cm base with sectionised parts.	37
25.	Cleveland Flash & Fire point Apparatus	Power (W)-1.5-2 KWH, Thermometer (deg. Celsius)-450 Semi-Automatic, 220 Volts	38
26.	Automatic Microprocessor Bomb Calorimeter	Automatic Bomb Calorimeter with water jacket, W/O puff insulation, Safety Device, Sensor Probe High Pressure flexible tubing set & certified Bomb Temperature Resolution 0.01 Degree C.	39
27.	Digital Redwood Viscometer	Material-Mild Steel, Automatic, Digital, 220 V	40
28.	Cut section working model of single plate dry clutch	Coil spring/ diaphragm type single plate clutch assembly suitably mounted on M.S stand	41
29.	Multiplate Clutch	Working metallic model of multiplate clutch mounted on metal base with handle drive arrangement.	41
30.	Cut section working model of four-wheeler transmission system	Synchromesh gear box suitably mounted on M.S stand	42

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
31.	Actual Cut Section Gear Box Car (Constant Mesh)	Full size unit prepared from original parts mounted on stand. Five forward one reverse gear box with gear operating level	42
32.	Actual Cut Section Automatic Gear Box Car (Internal Gear Mesh)	Full size unit prepared from original parts mounted on stand. Four or Five forward one reverse gear box with gear operating lever	42
33.	Cut section working model of sequential automatic transmission system	sequential automatic transmission system	43
34.	Carburetors	An original carburetor duly sectionised and mounted on base, Zenith type, S.U. type, Solex type, Carter type	23,45
35.	Computerized Brake performance Test Set-up	Max. Force - 200 kg	46
36.	Fuel consumption meter (Gravimetric and volumetric)	Measuring range 0 -500gm/min.	49
37.	Digital Steering Effort Meter	Angle, Time & Effort Measurement	49
38.	Hydraulic Inline Tester	Discharge (0 - 150 LPM), Pressure 0 - 400 bar, Temp. 0 - 120°C	51
39.	Hydraulic Power and Lifting Force Test Set-up	Max. Load 9000 kgf, Max Stroke - 2000 mm	51
40.	Working Model of Tractors Steering	metallic model with all essential parts. Complete mounted on polished wooden base of about 45x45 cm size.	51
41.	Hydraulic Brake Unit (two master cylinder and with four brake drums)	full size unit Suitably sectionised. Consisting of original parts such as- master cylinder assembly, wheel cylinder, brake shoes, brake drums and necessary connections. Completed with operating lever and mounted on heavy wooden base.	46
42.	Disc Brake	Properly constructed model, complete on base with operating lever. Disc Brake	46
43.	Mechanical Brake System	Suitably sectioned full-size unit. Consisting of original parts. Completed with operating lever and mounted on heavy wooden base.	46
44.	Tractor	Portable open construction model of tractor of convenient size. The chassis should consist of Front axle with wheels, Steering, Four-cylinder diesel engine, Clutch, Gear box, Differential Rear axle with wheel Brakes, radiator, Fuel Tank etc. By turning crank handle attached in front of the unit piston of the engine move up and down, cam shaft connected by gears opens and closes the intake and exhaust valves of each cylinder in proper sequence, lamp flash to show instant firing order, Motor Driven.	22-31, 41-46, 47-54
45.	Power Tiller	Type of start- Single cylinder, Horizontal water-cooled Diesel engine Electrical with key with safety neutral switch. Power -15 Hp category. Rated Rpm-2000, Displacement -995cc Bore×stroke-105mm×115mm, Specific fuel consumption 270gm/kwHr. weight -138 kg, Engine oil-3.5litre (15w 40 grade), Transmission-No of gears -6, Forward 12 Reverse, Minimum speed- 1.34 kmph., Maximum speed -14.86kmph, Brakes- Transmission brake and parking brakes, Gear oil7.5 lit (80 w 90 grade) Main clutch -Multiple clutch (Ceramic), clutch plate - Dia 152mm, Rotary tiller -No of blades -20, Side drive - Chain drive, Rotor speed Range -183 rpm and 304 rpm, Side power rake off 1200 rpm @engine rated rpm.	1 ,8, 22-31, 47-54

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

S. No	Titles	Author(s)	Publisher and Edition with ISBN
1.	Agricultural Engineering: A Practical Approach	P Kandasamy	New India Publishing Agency, 2021 ISBN-10 : 819476680X ISBN-13 : 978-8194766803
2.	The 2023-2028 World Outlook for Agricultural Tractors	Philip M. Parker	ICON Group International, 2022 ASIN : B09WCBRL8Z, B0BGKZ9QQQ
3.	Fundamentals of Tractor Design	Karl Theodor Renius	Springer, 1st ed., 2020 ISBN-10 : 3030328031 ISBN-13 : 978-3030328030
4.	Farm Tractor Power Tiller Maintenance & Repair	SC Jain	VISIONIAS, 2020 ASIN : B0CD5PPYPK
5.	How to Rebuild and Restore Farm Tractor Engines	Spencer Yost	Motor books Intl, 1 st Ed., 2000 ISBN-10 : 0760306613 ISBN-13 : 978-0760306611
6.	How to Restore Your Farm Tractor: Choosing a tractor and setting up a workshop - Engine, transmission, and PTO rebuilds - Bodywork, painting, and decals and badging	Tharran E Gaines	Publisher : Motorbooks, 2020 ASIN : B08DKCV9YB
7.	Maintenance and repair of farm machinery: Understanding and management of farm machines	Charles-magnus Nwachukwu-udaku Clinton Nwachukwu	Kindle Edition, 2022, ASIN : B0B72GKZZS
8.	Fundamentals and Application of Farm Machinery & Power Perfect	J Mahapatra MK Mohanty, A Mishra	Narendra Publishing House; 1st ed. 2023 ASIN : B0CQ8TGT4T
9.	Farm Tractor, Power Tiller Rakh Rakhav Avam Marammat (Farm Tractor, Power Tiller Maintenance & Repair) Hindi	S. C. Jain C. R. Rai	Standard Publishers Distributors ,2019 ISBN-10 : 8180142256 ISBN-13 : 978-8180142253
10.	Principles of Agricultural engineering Vol- 1	A.M. Michel & T.P. Ojha	Jain Brothers, 15 th Edition,2023 ASIN : B0BT2NRYB3

(b) Online Educational Resources:

- 1) <https://ecourses.icar.gov.in/>
- 2) <https://ecoursesonline.iasri.res.in/>
- 3) <https://vikaspedia.in/agriculture>
- 4) <https://youtu.be/qxWpMT5L6wo> -Status of Farm Power in India <https://youtu.be/UfDKb7AcTAc> -Sources of Farm Power, I.C. engines, working principles of I C engines
- 6) <https://youtu.be/fD7GOrF7laY> - Working principles of I C engines
- 7) comparison of two stroke and four stroke cycle engines
- 8) <https://youtu.be/kU5G20s4ILA> -Comparison of two stroke and four stroke cycle engines

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

- Lab Manuals of different tractor parts and components
- WWW.tnau.com

A) Course Code	: 2425402 (T2425402/P2425402/S2425402)
B) Course Title	: Fluid Mechanics & Hydraulic Machinery
C) Pre- requisite Course(s)	: Engineering Mechanics
D) Rationale	:

In engineering field knowledge of fluid properties, fluid flow and fluid machinery are essential in all fields of engineering. Hydraulic machines have important role in water supply, irrigation, power generation and also in most of the engineering segments. This course is intended to develop the skills to estimate loss in pipes, efficiency of hydraulic machines like turbine pumps etc. and select a pump for a particular application. Diagnose and rectify the faults in pumps and turbines, replace pressure gauges and other accessories on hydraulic machines turbines, and apply their knowledge in hydraulics to select appropriate devices like pressure gauges, valves, flow devices, pipes etc. for different field applications.

- 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 various fluid characteristics.
- CO-2. Apply the fluid flow energy equations to real field situations.
- CO-3. Analyze various losses in flow through pipes
- CO-4. Select relevant turbine as per the situation.
- CO-5. Select a relevant pump as per the requirement

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

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				
2425402	Fluid Mechanics & Hydraulic Machinery	03	-	04	02	09	06

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)	
2425402	Fluid Mechanics & Hydraulic Machinery	30	70	20	30	20	30	200

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.

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: T2425402

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO.1a Compare the given two fluids based on the given physical properties.</p> <p>TSO.1b Choose the relevant pressure</p> <p>TSO.1c Measuring device for the given situation with justification.</p> <p>TSO.1d Calculate the Hydrostatic forces in the given situation as per the given data.</p> <p>TSO.1e Calculate pressure head for a given condition.</p> <p>TSO.1f Calculate centre of pressure and total pressure of regular immersed bodies.</p> <p>TSO.1g Calculate Metacentric height and Centre of buoyancy of the given floating body.</p>	<p>Unit-1.0 Properties of Fluid and Fluid Pressure</p> <p>1.1 Introduction and classification of fluid.</p> <p>1.2 Fluid properties- Density, Specific gravity, specific weight, specific volume, Dynamic & Kinematic viscosity, Surface tension, Capillarity, Vapour pressure, Compressibility, Bulk modulus.</p> <p>1.3 Types of fluids: Ideal, Real, Newtonian, Non-Newtonian, Plastic</p> <p>1.4 Pressure, Fluid pressure, pressure head, Pressure Intensity, Concept of absolute Vacuum, Gauge Pressure, Atmospheric Pressure, Absolute Pressure,</p> <p>1.5 Pressure measurement- Manometer, U- tube manometer, Incline manometer, Inverted U manometer, Piezometer.</p> <p>1.6 Concept of Total pressure, Centre of pressure, Pascal's law, Hydrostatic forces on plane and curved surface immersed in liquid and simple problems on it, Metacenter</p>	CO1
<p>TSO.2a Identify the given type of fluid flow.</p> <p>TSO.2b Identify the various forms of energy related to given fluid flow.</p> <p>TSO.2c Calculate the total energy in a given fluid.</p> <p>TSO.2d Apply the continuity equation to given real system.</p> <p>TSO.2e Solve numerical problems on Bernoulli equations</p>	<p>Unit-2.0 Fluid Flow</p> <p>2.1 Various forms of energies applicable to fluid flow – Potential energy, Kinetic energy, Pressure energy, Total energy, Types of fluid flows- Steady, unsteady, uniform, non-uniform, laminar and turbulent flow, Path line and Stream line, Concept of datum pressure, Velocity and total head of fluid in motion.</p> <p>2.2 Continuity equation, Energy equation- Steady flow energy equation and derivation of Bernoulli Theorem and its assumption and practical application.</p> <p>2.3 Flow measurement- Construction, Working and application of Venturi meter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge, Vena-Contraction, coefficient of contraction and numerical problems..</p>	CO2
<p>TSO.3a Determine the flow is laminar or turbulent in the pipe flow.</p> <p>TSO.3b Calculate the different types of minor and major losses.</p> <p>TSO.3c Calculate the loss of head in fluid flow through pipes in a given situation as per the given data.</p> <p>TSO.3d Explain various losses in flow through pipes, fittings and valves.</p>	<p>Unit 3.0 Flow through Pipes</p> <p>3.1 Flow Through Pipes- Laminar and turbulent flows</p> <p>3.2 Viscous flow- Concept of viscosity of fluids, Reynolds number and its criteria for plate and pipes, Darcy's Weisbach equation and Chezy's equation for frictional losses, loss of head due to friction in pipe, Hagen- Poiseuille formula</p> <p>3.3 Flow through pipes- Pipes in series, Pipes in parallel, Head losses- various types of minor</p>	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO.3e Solve numerical based on continuity equation, laws of friction and losses in flow through pipes.</p> <p>TSO.3f Explain the effect of water hammer due to the sudden change in velocity and pressure of the given fluid.</p>	and major energy loss occur in fluid flow through pipes. H.G.L. and T.E.L., surge tank, water hammer and its effects.	
<p>TSO.4a Calculate the impact of jet on flat plate.</p> <p>TSO.4b Calculate the impact of jet on curved plate.</p> <p>TSO.4c Calculate the force exerted by impact of jet plate in stationary and moving blades</p> <p>TSO.4d Draw the layout of hydroelectric power pant.</p> <p>TSO.4e Select suitable turbine for a given site/situation with justification.</p> <p>TSO.4f Describe the construction and working of the given water turbines.</p> <p>TSO.4g Describe the construction and working of the given draft tube.</p> <p>TSO.4h Calculate the work done, power, efficiency of turbines.</p> <p>TSO.4i Analyze the performance of turbine.</p>	<p>Unit 4.0 Impact of jets & Hydraulic Turbines</p> <p>4.1 Impact of jet on flat and curved plate in stationary and moving blades, Simple Numerical on work done and efficiency.</p> <p>4.2 Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines,</p> <p>4.3 Functions and working principle of Impulse and reaction turbine, Comparison of impulse and reaction turbine</p> <p>4.4 Construction, function and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes– types and construction, Concept of cavitation in turbines and benefit of draft tubes</p> <p>4.5 Calculation of Work done, Power, efficiency of turbines, and Unit quantities</p> <p>4.6 Selection of turbine on the basis of head and discharge available.</p> <p>4.7 Safety precaution on turbines</p>	CO4
<p>TSO.5a Identify the different types of hydraulic pumps</p> <p>TSO.5b Describes construction and working of the given pump.</p> <p>TSO.5c Select suitable Pump for a given application with justification.</p> <p>TSO.5d Explain construction and working of the given reciprocating pump.</p> <p>TSO.5e Calculate the work done and overall efficiency and power required for the given pump.</p> <p>TSO.5f Analyze the performance of pumps.</p>	<p>Unit-5.0 PUMPS</p> <p>5.1 Centrifugal Pumps – construction, working Principle and applications of centrifugal pump, Classification of centrifugal pump, impellers, casing,</p> <p>5.2 Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency.</p> <p>5.3 Reciprocating Pumps- Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation. use of air vessels, Comparison of centrifugal and reciprocating pump</p> <p>5.4 Submersible pump- Construction, working principle and application of submersible pump.</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425402

Practical/Lab Session Outcomes (LSOs)	S.No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Determine viscosity of given liquid	1	Use viscometer to determine the viscosity of a given liquid.	CO1
LSO 1.2 Measure the rise of liquid level	2	Measure the rise of liquid level using capillary action in capillary tube.	CO1
LSO 1.3 Measure specific gravity of any given fluid	3	Determine the specific gravity of any given fluid	CO1
LSO 1.4 Measure the pressure of the given fluid.	4	Use manometer/ incline manometer to measure the pressure of the given fluid.	CO1
LSO 1.5 Measure meta-centric height of ship model.	5	Determine the meta-centric height of ship model.	CO1
LSO 2.1 Measure discharge through a pipe using Venturi meter.	6	Determine Coefficient of Discharge of Venturi meter.	CO2
LSO 2.2 Measure discharge through a pipe using Orifice meter.	7	Determine Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orifice meter.	CO2
LSO 2.3 Determine the coefficient of friction of flow through pipes.	8	Determine coefficient of friction of flow through pipes.	CO2
LSO 2.4 Measure static pressure	9	Experimentally justify Bernoulli's theorem for a viscous and incompressible fluid.	CO2
LSO 2.5 Measure pressure energy, kinetic energy and datum energy of a given flowing fluid	10	Determine the pressure energy, kinetic energy and datum energy of a given flowing fluid.	CO2
LSO 3.1 Measure discharge through given pipe	11	Determine discharge through a given pipe using orifice meter, pitot tube and venturi meter.	CO3
LSO 3.2 Determine Cc, Cd, Cv for different types of orifices.	12	Determine Cc, Cd, Cv for different types of orifices.	CO3
LSO 3.3 Determine head loss	13	Determine loss of head due to A. Sudden enlargement B. Sudden contraction C. Friction in pipes	CO3
LSO 3.4 Determine the different types of flow Patterns	14	Determine the different types of flow Patterns by Reynolds's experiment	CO3
LSO 3.5 Measure the flow characteristic	15	Measure the flow characteristic of given flowing fluids	CO3
LSO 3.6 Calculate the minor losses of flow through pipes.	16	Determination of minor losses of flow through pipes.	CO3
LSO 4.1 Calculate the overall efficiency of the given turbine.	17	Determine overall efficiency using Pelton turbine.	CO4
	18	Determine overall efficiency using Francis/Kaplan turbine.	CO4
LSO 4.2 Determine the reaction force produced by the impact of a jet of water on to various target vanes	19	Investigate the reaction force produced by the impact of a jet of water on to various target vanes	CO4
LSO 4.3 Plot characteristics curve of the given turbine	20	Plot the characteristic curves of Pelton wheel Francis Turbine Kaplan turbine	CO4
LSO 5.1 Calculate overall efficiency of the given pump.	21	Determine overall efficiency using Centrifugal pump.	CO5
	22	Determine overall efficiency using Reciprocating pump.	CO5
LSO 5.2 Determine the performance characteristics and power required for the given pump	23	Determine the power required to drive the given reciprocating pump.	CO5
	24	Determine the performance characteristics of: Centrifugal pump Reciprocating Pump	CO5

L) **Suggested Term Work and Self Learning: S2425402** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Explain the different types of pressure measuring devices.
- ii. Explain different types of discharge measuring devices.
- iii. Describe a hydroelectric power plant.
- iv. Differentiate the hydraulic turbine on the basis of head, input energy available.
- v. Explain the various types of head in the centrifugal pump.

b. Micro Projects:

- i. Prepare a pipe layout water supply of your lab from supply reservoir and calculate the loss of head.
- ii. Prepare a demonstration model of hydroelectric power plant.
- iii. Calculate running cost of your household pump and verify the electricity bill.
- iv. Visit a hydroelectric power plant and write report.
- v. Conduct market survey of hydraulic turbine suppliers and prepare report on technical specifications, area of applications, cost, material of different parts and maintenance procedure.
- vi. Download catalogue of pump manufacturer and compare their parameter.

C. Other Activities:

1. Seminar Topics:

- Different types of manometers and their applications.
- Comparison between orifice meter and venturi meter.
- Different types of hydraulic turbines and their application areas.
- Different types of hydraulic pumps and their application areas.

2. Visit:

- Visit nearby shops to identify different PVC and GI pipe fittings.
- Visit nearby shops to identify different pumps. Collect manufacturing catalogues related to the same and compare their salient features.

3. Self-Learning Topics:

- Prepare journals based on practical performed in laboratory.
- Use various mechanical measuring instruments and equipments related to fluid mechanics and machinery.
- Read and use specifications of the hydraulic machines and equipments.
- Prepare power point presentation or animation for understanding constructional details and working of different hydraulic machines.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate CO attainment.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	10%	15%	-	-	20%	20%
CO-2	10%	20%	10%	25%	-	10%	20%
CO-3	15%	20%	15%	25%	33%	15%	20%
CO-4	30%	20%	30%	25%	33%	15%	20%
CO-5	30%	30%	30%	25%	34%	40%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self-learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentages given are approximate.
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Properties of Fluid and Fluid Pressure	9	CO1	11	3	4	4
Unit-2.0 Fluid flow	11	CO2	14	4	4	6
Unit-3.0 Flow through pipes	10	CO3	14	5	4	5
Unit 4.0 Impact of jets & Hydraulic Turbines	9	CO4	14	3	5	6
Unit-5.0 Pumps	9	CO5	17	4	4	9
Total Marks	48	-	70	19	21	30

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment..

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1	Use viscometer to determine the viscosity of a given liquid.	CO1	40	50	10
2	Measure the rise of liquid level using capillary action in capillary tube.	CO1	40	50	10
3	Determine the specific gravity of any given fluid	CO1	40	50	10
4	Use manometer/ incline manometer to measure the pressure of the given fluid.	CO1	40	50	10
5	Determine the meta-centric height of ship model.	CO1	40	50	10
6	Determine Coefficient of Discharge of Venturi meter.	CO2	40	50	10
7	Determine Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orifice meter.	CO2	40	50	10
8	Determine coefficient of friction of flow through pipes.	CO2	40	50	10
9	Experimentally justify Bernoulli's theorem for a viscous and incompressible fluid.	CO2	40	50	10
10	Determine the pressure energy, kinetic energy and datum energy of a given flowing fluid.	CO2	40	50	10
11	Determine discharge through a given pipe using orifice meter, pitot tube and venturi meter.	CO3	40	50	10
12	Determine Cc, Cd, Cv for different types of orifices.	CO3	40	50	10
13	Determine loss of head due to Sudden enlargement Sudden contraction Friction in pipes	CO3	40	50	10
14	Determine the different types of flow Patterns by Reynolds's experiment	CO3	40	50	10
15	Measure the flow characteristic of given flowing fluids	CO3	40	50	10
16	Determination of minor losses of flow through pipes.	CO3	40	50	10
17	Determine overall efficiency using Pelton turbine.	CO4	40	50	10
18	Determine overall efficiency using Francis/Kaplan turbine.	CO4	40	50	10
19	Investigate the reaction force produced by the impact of a jet of water on to various target vanes	CO4	40	50	10
20	Plot the characteristic curves of • Pelton wheel • Francis Turbine • Kaplan turbine	CO4	40	50	10
21	Determine overall efficiency using Centrifugal pump.	CO5	40	50	10
22	Determine overall efficiency using Reciprocating pump.	CO5	40	50	10
23	Determine the power required to drive the given reciprocating pump.	CO5	40	50	10
24	Determine the performance characteristics of: • Centrifugal pump • Reciprocating Pump	CO5	40	50	10

Legend:

PRA* : Process Assessment

PDA** : Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment and Tools: The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments. As well as aid to procure equipment by administrators.

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Red wood viscometer	Electrically Heated with Digital temperature controller cum indicator	1
2	Capillary tube	Capillary tube of different diameters, beaker/petri dish,	2
3	Beaker, Pipette, Electronic balance, Thermometer	The Electronic Digital Balance 2kg x 0.5 gram, Beaker 500 ml, Pipette 50 ml, digital thermometer	3
4	manometer	Glass tube 50 mm, Complete set up for pressure measurement, wall or stand mounted, Mercury as manometric fluid	4
5	Differential Manometer	Glass tube 50 mm, Complete set up for demonstration of pressure measurement, wall or stand mounted, Mercury as manometric fluid	4
6	Venturimeter setup for measurement of discharge	Complete set up for measurement of discharge including power supply, water tank, and all accessories and instruments.	6,11
7	Orificemeter setup for measurement of discharge	Complete set up for measurement of discharge including power supply, water tank, and all accessories and instruments.	7,11
8	Setup for Bernoulli's Theorem	Complete set up for to verify the Bernoulli's theorem including power supply, water tank, and all accessories and instruments.	9
9	Setup for Friction losses through Pipes	Complete set up for friction losses including power supply, water tank, and all accessories and instruments.	8
10	Setup for losses due to enlargement & contraction in pipes	Complete set up of enlarge and contraction pipe, including power supply, water tank, and all accessories and instruments.	8, 10, 13
11	Reciprocating Pump test rig	Complete setup to test performance parameter of reciprocating pump up to 5 HP	22,23,24
12	Centrifugal Pump test rig	Complete setup to test performance parameter of Centrifugal Pump up to 5 HP	21,24
13	Pelton wheel test rig	Complete setup to test performance parameter and characteristics	17,20
14	Kaplan turbine test rig	Complete setup to test performance parameter and characteristics	18,20
15	Francis turbine test rig	Complete setup to test performance parameter and characteristics	18,20
16	Impact of jet apparatus	Complete set up including Sump Tank, Measuring tank, nozzles and vanes.	19
17	Reynolds Apparatus	Complete setup consisting of Borosilicate Glass tube, Stainless steel Dye vessel, Copper/Stainless Steel Capillary Tube, Water Tank, arrangement for flow measurement, stop watch and power supply	14
18	Metacentric height apparatus	Complete setup for Metacentric height calculation including tank , ship model	5

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1	Hydraulics, Fluid Mechanics and Hydraulic Machines.	Khurmi R.S. Khurmi N.	S. Chand and Co. Ltd., New Delhi, 2014 ISBN-10: 8121901626, ISBN-13: 978-8121901628
2	Fluid mechanics and hydraulic machines.	Bansal R.K.	Laxami Publication, New Delhi, 2018 ISBN-10: 8131808157, ISBN-13: 978-8131808153
3	Fluid mechanics and hydraulic machines	Rajput R.K.	S. Chand and Co. Ltd., New Delhi, 2006 ISBN-10: 8121916666, ISBN-13: 978-8121916660
4	Hydraulics & Fluid Mechanics Including Hydraulics	Modi P.N. Seth S.M.	Rajsons Publications Pvt Ltd, New Delhi, 2017, ISBN-10: 8189401262, ISBN-13: 978-8189401269
5	Textbook of Fluid Mechanics and Hydraulic Machines	Pati Sukumar	McGraw Hill Education New Delhi, 2017 ISBN-10: 1259006239, ISBN-13: 978-1259006234

(b) Online Educational Resources:

1. Nptel course- <http://nptel.ac.in/courses/112105171/>
2. fluid and their propertie-https://www.youtube.com/results?search_query=fluid+and+their+propertie
3. Continuity equation-- https://www.youtube.com/results?search_query=Continuity+equation+
4. Pressure measurement- https://www.youtube.com/results?search_query=Pressure+measure
5. Pascal's law - https://www.youtube.com/results?search_query=Pascal%E2%80%99s+law
6. Metacenter-- https://www.youtube.com/results?search_query=2.4%09Metacenter
7. buoyancy - https://www.youtube.com/results?search_query=buoyancy
8. Fluid flow energy equation -
https://www.youtube.com/results?search_query=Fluid+flow+energy+equation
9. Fluid flow - https://www.youtube.com/results?search_query=Fluid+flow+
10. Flow measurement- https://www.youtube.com/results?search_query=2.%09Flow+measurement
11. Venturimeter- https://www.youtube.com/results?search_query=Venturimeter
12. Classification of hydraulic turbines-
https://www.youtube.com/results?search_query=5.1%09Classification+of+hydraulic+turbines+
13. Francis Turbine - https://www.youtube.com/results?search_query=%29+Francis+Turbine+
14. Kaplan turbine- https://www.youtube.com/results?search_query=Kaplan+turbine
15. Centrifugal pumps- https://www.youtube.com/results?search_query=Centrifugal+pumps-+
16. Reciprocating pumps- https://www.youtube.com/results?search_query=Reciprocating+pumps-

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

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

- A) **Course Code** : 2411403(T2411403/P2411403/S2411403)
- B) **Course Title** : Plant Genetics and Nursery Technology
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

Plant Nursery management involves working in a plant nursery or greenhouse, responsible for cultivating and caring for plants. They propagate plants through seeds, cuttings, or grafting, ensuring healthy growth and development. It involves management of greenhouse conditions, water plants and apply fertilizers for optimal growth. Monitoring and addressing pest and disease issues to maintain plant health. Plant genetics helps to understand basic concepts of the ultrastructure of cell, cell organelles, chromosomes and nucleic acids, principles of inheritance and acquaint with the fundamentals of chromosomal and cytoplasmic inheritance, sex determination, mutations and chromosomal aberrations.

- 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 various genetic principles in crop improvement.
- CO-2.** Apply gene mapping techniques and its utilization in novel plant breeding
- CO-3.** Manage nursery effectively and efficiently
- CO-4.** Use plant propagation techniques
- CO-5.** Monitor and Maintain nursery plant health.

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

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				
2411403	Plant Genetics and Nursery Technology	03	-	04	02	09	06

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) optional 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)	
2411403	Plant Genetics and Nursery Technology	30	70	20	30	20	30	200

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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2411403

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.1a</i> Apply Mendel's law and theory of inheritance</p> <p><i>TSO.1b</i> Explain the genetic material and the function of gene regulation</p> <p><i>TSO.1c</i> Describe about the gene isolation and synthesis</p> <p><i>TSO.1d</i> Examine the genetic disorders and eugenics</p> <p><i>TSO.1e</i> Differentiate between DNA and RNA</p> <p><i>TSO.1f</i> Explain importance of different genetic parameters in crop improvement</p> <p><i>TSO.1g</i> Estimate combining ability and gene action through different mating design</p> <p><i>TSO.1h</i> Determine genotype-environmental interactions using different stability models</p>	<p>Unit-1.0 Plant Genetics</p> <p>1.1 Genetics revolution in the life sciences</p> <p>1.2 Cell structure and cell division, Early concepts of inheritance</p> <p>1.3 Mendel's laws, Chromosomal theory of inheritance, Mendelian inheritance, probability, and chi, Sex determination in plants – Melandrium, papaya, maize.</p> <p>1.4 DNA: Structure and replication</p> <p>1.5 RNA: Transcription and processing</p> <p>1.6 Proteins and their synthesis</p> <p>1.7 Single-gene inheritance</p> <p>1.8 Independent assortment of genes</p> <p>1.9 Recombination and genetic mapping in eukaryotes, Somatic cell genetics</p> <p>1.10 Gene isolation and manipulation</p> <p>1.11 Application of recombinant DNA</p>	CO1
<p><i>TSO.2a</i> Explain genetic changes for improving gene make up of plant to develop new cultivars.</p> <p><i>TSO.2b</i> Explain genetic resources and evolution</p> <p><i>TSO.2c</i> Explain cultivar development</p> <p><i>TSO.2d</i> Categorize genetic consequences of plant reproductive systems</p> <p><i>TSO.2e</i> Assess role of variation and selection in plant breeding</p> <p><i>TSO.2f</i> Analyze the breeding methods for crop improvement</p> <p><i>TSO.2g</i> Apply breeding techniques in lab and field</p>	<p>Unit -2.0 Genomics and Plant Breeding</p> <p>2.1 Introduction to Genomics, dynamic genomics</p> <p>2.2 Mutation and repair</p> <p>2.3 Large-scale chromosomal changes</p> <p>2.4 Regulation of eukaryotic gene expression and gene expression in bacteria</p> <p>2.5 Gene interaction, Population genetics</p> <p>2.6 The inheritance of complex traits</p> <p>Plant breeding</p> <p>2.7 Objectives and role of plant breeding - historical perspective – activities in Plant</p> <p>2.8 Breeding, Reproduction and pollination system in plants- Mechanisms promoting self and cross pollination in crop plants.</p> <p>2.9 Self-incompatibility – classifications – mechanisms - application – measures to overcome and limitations. Sterility – male sterility</p> <p>2.10 Introduction – classification – CMS, GMS, CGMS - inheritance and applications</p> <p>2.11 Breeding techniques for self-pollinated crops – Pure line selection and Mass selection. Hybridisation and selection Pedigree method Bulk method and backcross method.</p>	CO 2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.3a</i> Explain the soil preparation techniques for the given situation</p> <p><i>TSO.3b</i> Select plant growth regulators as per given requirement</p> <p><i>TSO.3c</i> Explain different specific surface configurations of sowing, planting, inter cultivation and plant protection.</p> <p><i>TSO.3d</i> Differentiate between seed drill and planter.</p> <p><i>TSO.3e</i> Select equipment's for nursery maintenance as per the requirement</p> <p><i>TSO.3f</i> Describe the planter for the given application</p> <p><i>TSO.3g</i> Design layout of nursery facilities</p> <p><i>TSO.3h</i> Design greenhouse and shade structure for the given situation</p> <p><i>TSO.3i</i> Design nursery layout</p> <p><i>TSO.3j</i> Maintain nursery records</p>	<p>Unit-3.0 Nursery Management</p> <p>3.1 Introduction to nursery, classification of nursery</p> <p>3.2 Principles of plant nursery management</p> <p>3.3 Soil preparation and potting, de-potting and repotting techniques</p> <p>3.4 Irrigation and fertilization practices, Plant growth regulators</p> <p>3.5 Nursery bed, Equipment used for bed preparations and precautions</p> <p>3.6 Nursery- site selection, lay out, records; Nursery structures</p> <p>3.7 Problems in nursery management and their control, Nursery inventory management</p> <p>3.8 Nursery equipment operation and maintenance</p> <p>3.9 Safety protocols in the nursery environment</p>	CO 3
<p><i>TSO.4a</i> Describe the different methods of sowing of seed.</p> <p><i>TSO.4b</i> Compare metering mechanism on the basis of given criteria.</p> <p><i>TSO.4c</i> Analyze the factors affecting the plant growth.</p> <p><i>TSO.4d</i> Apply relevant methods of plant propagation in the given situation</p> <p><i>TSO.4e</i> Maintain genetic diversity.</p> <p><i>TSO.4f</i> Select seed collection and processing method for the given situation.</p> <p><i>TSO.4g</i> Describe tissue culture and micropropagation techniques for the given plant.</p> <p><i>TSO.4h</i> Describe waste management and recycling methods</p>	<p>Unit-4.0: Plant Propagation Techniques</p> <p>4.1 Methods of plant propagation- Sexual propagation, Asexual propagation, Micropropagation</p> <p>4.2 Seed sowing techniques and seedling management</p> <p>4.3 Factors affecting plant growth, growing media, function and characteristics of growing media, types of growing media</p> <p>4.4 Seed as a propagule, Germination of seeds, Seed dormancy and viability</p> <p>4.5 Seed production - method of collection and processing, Seed treatment</p> <p>4.6 Classes of seed, Seed testing, commercial vegetable seedling production</p> <p>4.7 Cutting propagation, grafting techniques and budding technique</p> <p>4.8 Tissue culture and micro-propagation</p>	CO4
<p><i>TSO.5a</i> Maintain plant health</p> <p><i>TSO.5b</i> Prepare plan for health monitoring plan for the given plant.</p> <p><i>TSO.5c</i> Analyze the nutritional deficiencies in the given plant.</p> <p><i>TSO.5d</i> Select fertilizer and micronutrient for the given situation.</p> <p><i>TSO.5e</i> Identify and manage plant pests, diseases, and other health-related issues in a nursery setting,</p> <p><i>TSO.5f</i> Design relevant preventive and curative measures for the given plant.</p> <p><i>TSO.5g</i> Select pest for the given disease and health related issue.</p>	<p>Unit-5.0 Plant Health Management</p> <p>5.1 Plant health monitoring and maintenance</p> <p>5.2 Essential plant nutrients, their functions and mobility, soil treatment and seed treatment</p> <p>5.3 Nutritional deficiencies and remedies</p> <p>5.4 Integrated nutrient management, Complex and mixed fertilizers, micronutrients and their carriers.</p> <p>5.5 Organic manures, Different approaches for fertilizer recommendation, Plant bio-regulators, Type of plant bio-regulators</p> <p>5.6 Common pests and diseases in nursery plants</p> <p>5.7 Integrated pest management strategies</p> <p>5.8 Safe handling and disposal of pesticides</p> <p>5.9 Waste disposal and recycling practices</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2411403

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO 1.1. Perform chromosome mapping	1.	Use three-point test cross for chromosome mapping	CO1
	2.	Mapping of gene by tetrad analysis	CO1
LSO 1.2. Perform genetic analysis	3.	Perform Induction and detection of mutations through genetic tests	CO1
	4.	Extract DNA and PCR amplification for the given plant	CO1
	5.	Detect transgenes in the exposed plant material	CO1
LSO 1.3. Extract proteins and isozymes from the plants	6.	Use Agrobacterium mediated method and Biolistic gun to extract proteins and isozymes.	CO1
LSO 2.1. Use pant breeder kit to collect germplasm	7.	Use different instruments, tools and accessories of plant breeder kit	CO2
	8.	Collect germplasm from the given crops using breeder kit	CO2
LSO 2.2. Perform Emasculation and hybridization techniques	9.	Control pollination through emasculation and hybridization techniques in the given self-pollinated crops and cross -pollinated crops.	CO2
LSO 2.3. Estimate heritability and genetic advance	10.	Determine and evaluate different types of male sterility system and their utilization in the given plant breeding	CO2
	11.	Determine mode of reproduction in a given plant.	CO2
	12.	Calculate heterosis, heterobelitionsis and standard heterosis and inbreeding depression.	CO2
	13.	Determine mode of pollination in a given crop and extent of natural out crossing	CO2
LSO 3.1. Develop Green house and shade structure	14.	Prepare greenhouse and shade structure for the given situation	CO3
LSO 3.2. Develop glasshouse and polyhouse	15.	Prepare glasshouse, polyhouse for the given situation	CO3
LSO 3.3. Prepare plant growth regulators as per need	16.	Prepare plant growth regulators for seed germination and vegetative propagation.	CO3
LSO 3.4. Prepare plant material	17.	Prepare plant material for potting.	CO3
LSO 3.5. Prepare a raised nursery bed and seed bed	18.	Prepare a raised nursery bed.	CO3
	19.	Prepare the seedbed using soil solarization technique	CO3
LSO 3.6. Operate and maintain nursery equipment	20.	Operate and maintain nursery equipment following Safety procedures and protocols	CO3
LSO 3.7. Calculate the field efficiency & field capacity	21.	Determine the field capacity and field efficiency of the given nursery implements	CO3
LSO 4.1. Use relevant potting and container for the given plants	22.	Select relevant potting and container for the given plants	CO4
LSO 4.2. Prepare soil for the given seedlings	23.	Prepare soil for the given plantation	CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
	24.	Sow the given seed using standard procedure	CO4
	25.	Raise seedlings on beds and in trays	CO4
LSO 4.3 Test different types of seeds for production	26.	Test for seed uniformity	CO4
	27.	Test seed for the production purpose	CO4
	28.	Perform seed treatments for breaking dormancy and inducing vigorous seedling growth on the given seed	CO4
LSO 4.4 Prepare specific surface configurations as per need	29.	Prepare specific surface configurations of sowing, planting, inter cultivation and plant protection	CO4
LSO 4.5 Design nursery layout	30.	Design nursery layout for the given landscape.	CO4
LSO 4.6 Setup irrigation system as per requirement	31.	Setup irrigation system for the given situation	CO4
LSO 4.7 Perform grafting, budding, layering and cutting technique on the given plant	32.	Apply grafting, budding, layering and cutting technique on the given plant	CO4
LSO 4.8 Perform tissue culture	33.	Perform tissue culture for the given plant	CO4
LSO 4.9 Use growing media	34.	Select relevant growing media for the given plant and seeds.	CO4
LSO 5.1 Perform nutrient analysis	35.	Determine nutrients in the given soil sample and the plant.	CO5
LSO 5.2 Handle the chemical safely and effectively	36.	Dispose the chemical following correct procedure and safety precaution.	CO5
LSO 5.3 Determine the diseases and other health-related issues	37.	Determine the diseases and other health-related issues in the given plant.	CO5
LSO 5.4 Use manures and fertilizers safely and effectively	38.	Identify the given manures and fertilizers	CO5
	39.	Apply manures and fertilizers as per the situation following correct procedure and safety precaution.	CO5

L) Suggested Term Work and Self Learning: S2411403 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.
- Explain basic principles and running of amplified DNA
 - Describe genetic principles using laboratory organisms;
 - Dissect the floral parts of given sample and mount them on black mounting paper. Draw the figures and label properly.
 - Explain procedure of hybridization technique in field on given samples
 - Explain Yield improvement, Increased adaptability, Resistance to yellow rust, aphid and nematode, Improvement in nutritional quality, Improvement in attributes related to malt industry

b. Micro Projects:

- i. Visit to a commercial nursery and prepare report regarding erection of nursery structures, green house and transgenic glasshouse
- ii. Visit to the 05 nursery and prepare a report on management of nursery pests and diseases.
- iii. Visit to the 05 nursery and prepare a report on different types of nursery layout and record keeping.
- iv. Develop a model of different types of green house and glass house

c. Other Activities:

1.Seminar Topics:

- Anti-sense RNA and ribozymes and MicroRNAs (miRNAs)
- Advancements in nursery implements.
- Gene families and clusters.
- Micronutrients and their role

2. Visits:

Visit nearby nursery and forests to identify different types of disease in different plants and prepare a report based on the criteria like controlling methods to control diseases, nutrients required, manure used etc.

3. Self- learning topics:

- Advanced technology used in plant genetics and nursery development
- Research and development done by CIAE.
- Application of automation in the area of nursery development and management
- Appropriate mechanization technology for energy management in nursery

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	10%	20%	-	-	15%	20%
CO-2	20%	30%	20%	25%	25%	15%	20%
CO-3	20%	15%	20%	25%	25%	20%	20%
CO-4	20%	25%	20%	25%	25%	25%	20%
CO-5	20%	20%	20%	25%	25%	25%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Plant Genetics	9	CO1	11	5	6	6
Unit-2.0 Genomics and Plant Breeding	10	CO2	20	4	5	6
Unit-3.0 Nursery Management	10	CO3	12	3	4	5
Unit-4.0 Plant Propagation Techniques	10	CO4	15	4	5	5
Unit-5.0 Plant Health Management	9	CO5	12	4	4	4
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA * (%)	PDA ** (%)	
1.	Use three-point test cross for chromosome mapping	CO1	50	40	10
2.	Mapping of gene by tetrad analysis	CO1	50	40	10
3.	Perform Induction and detection of mutations through genetic tests	CO1	50	40	10
4.	Extract DNA and PCR amplification for the given plant	CO1	50	40	10
5.	Detect transgenes in the exposed plant material	CO1	50	40	10
6.	Use Agrobacterium mediated method and Biolistic gun to extract proteins and isozymes.	CO1	50	40	10
7.	Use different instruments, tools and accessories of plant breeder kit	CO2	50	40	10
8.	Collect germplasm from the given crops using breeder kit	CO2	50	40	10
9.	Control pollination through emasculation and hybridization techniques in the given self-pollinated crops and cross -pollinated crops.	CO2	50	40	10
10.	Determine and evaluate different types of male sterility system and their utilization in the given plant breeding	CO2	50	40	10
11.	Determine mode of reproduction in a given plant.	CO2	50	40	10
12.	Calculate heterosis, heterobeltionsis and standard heterosis and inbreeding depression.	CO2	50	40	10

S. No	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA * (%)	PDA ** (%)	
13.	Determine mode of pollination in a given crop and extent of natural out crossing	CO2	50	40	10
14.	Prepare greenhouse and shade structure for the given situation	CO3	50	40	10
15.	Prepare glasshouse, polyhouse for the given situation	CO3	50	40	10
16.	Prepare plant growth regulators for seed germination and vegetative propagation.	CO3	50	40	10
17.	Prepare plant material for potting.	CO3	50	40	10
18.	Prepare a raised nursery bed.	CO3	50	40	10
19.	Prepare the seedbed using soil solarization technique	CO3	50	40	10
20.	Operate and maintain nursery equipment following Safety procedures and protocols	CO3	50	40	10
21.	Determine the field capacity and field efficiency of the given nursery implements	CO3	50	40	10
22.	Select relevant potting and container for the given plants	CO4	50	40	10
23.	Prepare soil for the given plantation	CO4	50	40	10
24.	Sow the given seed using standard procedure	CO4	50	40	10
25.	Raise seedlings on beds and in trays	CO4	50	40	10
26.	Test for seed uniformity	CO4	50	40	10
27.	Test seed for the production purpose	CO4	50	40	10
28.	Perform seed treatments for breaking dormancy and inducing vigorous seedling growth on the given seed	CO4	50	40	10
29.	Prepare specific surface configurations of sowing, planting, inter cultivation and plant protection	CO4	50	40	10
30.	Design nursery layout for the given landscape.	CO4	50	40	10
31.	Setup irrigation system for the given situation	CO4	50	40	10
32.	Apply grafting, budding, layering and cutting technique on the given plant	CO4	50	40	10
33.	Perform tissue culture for the given plant	CO4	50	40	10
34.	Select relevant growing media for the given plant and seeds.	CO4	50	40	10
35.	Determine nutrients in the given soil sample and the plant.	CO5	50	40	10

S. No	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva- Voce (%)
			PRA * (%)	PDA ** (%)	
36.	Dispose the chemical following correct procedure and safety precaution.	CO5	50	40	10
37.	Determine the diseases and other health-related issues in the given plant.	CO5	50	40	10
38.	Identify the given manures and fertilizers	CO5	50	40	10
39.	Apply manures and fertilizers as per the situation following correct procedure and safety precaution.	CO5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Visit to commercial Nurseries /Agricultural Universities /KVK.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Plant Breeder's kit	Plant breeder kits having all the essential tools and accessories for selfing, artificial pollination and field observation	All
2.	Microscope	<p>Laser microscope- type- Diode pumped, solid state, Wavelength- approx 349 nm, Average pulse energy-120 μJ, Repetition rate 10 – 5000 Hz (free adjustable), Laser aperture control-continuously adjustable, Free intensity control 1-100%, UV offset freely adjustable and saved for each objective, Laser beam movement Via optics, Microscope stand (fully automated)</p> <p>Transmitted light (TL) axis</p> <ul style="list-style-type: none"> • Contrast methods-BF, optional PH, DF, POL, DIC (fully automated), • Illumination-LED (PMax = 15 W) Lamphousing, Automation- Automated illumination manager, Automated contrast manager, • Constant color intensity control (CCIC) for Halogen TL • Condenser-Condenser head S28, 0.55 NA Motorized 7x condenser disk Motorized polarizer • Filter cube turret-Motorized 5x or 8x • Automation- Fluorescence intensity manager (FIM) for brightness adjustment, Circular and rectangular field diaphragms for eyepiece or camera viewing Internal filter wheel and motorized Excitation Manager <p>Fluorescence axis</p> <ul style="list-style-type: none"> • Illumination-120 W metal halide or 100 W HBO • Cubes- approx. 8-10 filters • Focus Motorized - 5 electronic ratios, Includes parfocal function, Memory function for two z-positions • Objective turret- Motorized 7x M25 thread including dry 	All

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
		<p>and immersion modes</p> <p>Operation</p> <ul style="list-style-type: none"> • 6 to 8 programmable function buttons • Smart Move Controls for z (focus) movement and x, y (stage) movement, 4 programmable function buttons • Controls for z (coarse and fine focus) and x, y (stage) movement, 11 programmable function buttons • Touchscreen with information and control panels <p>Stand</p> <p>Display With integrated smart touchscreen Interfaces- 2 x USB 2.0, 2 x I2C</p> <p>Dimensions- With scanning stage: 649.6 mm height, 512.0 mm width, 596.5 mm depth</p> <p>System software (Operating System Microsoft® Windows</p> <ul style="list-style-type: none"> • Automated vision control (AVC+ basic) for automated cell recognition within field of view only Automated vision control (AVC+ professional) for fully or semi-automated cell recognition over freely defined area Integrated database to transfer relevant data (laser, microscope and camera; database as optional) <p>Package should include</p> <ul style="list-style-type: none"> • Dissection- Automated collection devices and positioning of PCR tubes, fully automated inspection mode, Multi-cutting over entire slide Save and load drawn shapes • User guidance- Workflow based graphical user interface, • Free scaling of drawn shapes, Save user profiles • Overview images in BF and Fluorescence • Control-Full laser control-Control software of microscope stand, Laser and illumination settings are linked to objectives <p>Interfaces- Export shape list data for Microsoft Excel or OpenOffice</p>	
3.	Microscope slide with sample	Sample microscopic slides	All
4.	Stage micrometer	Material: optical glass Size: 75mm x 25mm x 1mm. Division : 0.01mm Total length of scale is 1mm that is subdivided into 100 divisions, each division is 0.01mm	All
5.	Ocular micrometer	0.1mm High Precision Ocular Micrometer+0.01mm Stage Micrometer	All
6.	Reagents and supplies	5X EZ PXR Master Mix, Load Ready, Plant Genetics Lab Primers, DPX DNA extraction buffer, 100 bp DNA Ladder	All
7.	Freezer	Volume (L)- 170 to 398 Min. Temp- -50°C to -86°C. Power supply-220V	All
8.	TBE electrophoresis buffer	Supplied as liquid concentrate or powder Sufficient to prepare 600 ml of 1X working solution	All
9.	PCR tubes (100-150 no)	0.2 ml	All
10.	plastic tubes (50-100 no)	1.7 ml	All

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
11.	PCR thermal cycler	<ul style="list-style-type: none"> • 96 well x 0.2ml PCR tubes/ one 96 well plate/3X 32 wells • Gradient PCR = capable of testing 12 different temperatures simultaneously across a gradient range of 1-20 and a temperature gradient from 30 - 99° C, with minimum • 0.1° C increment in gradient • Peltier based heating and cooling • Block heat rate: 5.0°C/Sec • Adjustable ramp rate • Sample ramp Rate: 4.4°C/S • Temperature Range: 4-99°C/S • Temperature accuracy: ± 0.2°C • Temperature Uniformity: ±0.3°C (20-70°C) • Gradient technology should ensure identical ramp rates in both gradient and normal operation • Lid temperature range of 33-110°C • Display: LCD touch Screen, about 8.5in. • Ports: USB ports • programmable protocols, storage of minimum 1000 programmes 	All
12.	Horizontal gel electrophoresis apparatus	18 – 20 cm (Length) x 25 – 30 (Breadth) x 5- 7.5 cm (Height), 40-60 samples, multichannel pipette compatible combs and gel caster, Blue light transilluminator	All
13.	Micropipettes	2-20 µl adjustable volume	All
14.	Disposable micropipette tips	Disposable micropipette tips	All
15.	Flask or beaker to dissolve agarose	Distilled water for making agarose gels and diluting TBE buffer	All
16.	Microwave or hot plate	Built-in calibrated power settings, Stainless steel interior & exterior for easy maintenance, long life Digital countdown timer, accurate to 1 second, Number of power settings:5, High-performance vent system with standard 4 output; connect to fume hood or vent stack Microwave stirrers (no carousel necessary) for even microwave distribution, no hot spots, User friendly controls, icon-based functions, Tall chambers, for tall containers and vessels, Illuminated interiors with stain-resistant ceramic floors, 8' Ventilation Hose, User's Manual, Microwave Companion	All
17.	Accessories and supplies	Disposable laboratory gloves, Protective eyewear Permanent marker, Cup to dispose of tips	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Plant Propagation and Nursery Management	S K Kataria and Sons	S K Kataria and Sons, 2023 ISBN-10: 9383992530 ISBN-13: 978-9383992539

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
2.	Plant Propagation and Nursery Management	Tarai Ranjan Kumar	New India Publishing Agency, 2020 ISBN-9789389907247
3.	Principles of Plant Genetics and Breeding	Acquaah	Wiley, 3rd Edition, 2020 ISBN-9781119626329
4.	Essentials of plant nursery management	P.K. Ray	Scientific Publisher, 2 nd ed.2021 ISBN-9789389832754
5.	Nursery Management A Complete Guide for Nurseryman	Nayak, Manas Ranjan,	Satish Serial Publishing House, 2018 ISBN-9789386200679

(b) Online Educational Resources:

1. <https://ecourses.icar.gov.in/>
2. <http://ecoursesonline.iasri.res.in/>
3. <https://fimmtbudni.gov.in>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(a) Others:

1. Lab Manuals of different implements
2. WWW.tnau.com

- A) **Course Code** : 2411404(T2411404/P2411404/S2411404)
 B) **Course Title** : Water Resources Management and Pumps
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Water is natural resource and is potentially useful for humans and all forms of flora and fauna. About 97% of the water on earth is salty and only 3 percent is fresh. About 70% of that 3 percent share is frozen in glaciers and polar ice caps. This alarms us with the importance of **water resources management**. Water is essential for crop production and freshwater resources are widely used for crop production. Our nation 'Bharat' sustains 18% of the world population and nearly 16% of the cattle population on merely 2.4% of the land and only 4% of water resources. Although water is renewable in nature but water quality is still a big issue in many parts of the world. Pumping water from source and conveying it to the sink is an age-old requirement. Several kinds of human and animal powered water lifting and carrying devices are available. However, the breakthrough was achieved with the use of pumps, which is a device for transferring fluid from one point to another. It is categorized as a hydraulic mechanical machine to move fluid from a point of low pressure to point of high-pressure and it works adding pressure energy into the fluid. Be a positive displacement or a variable displacement, pumps have got multiple uses in many sectors of life with special importance in agriculture. Understanding the appropriate uses of different types of pumps will make the whole system more synergetic. This course aims to impart the requisite skills for adoption, planning and execution of the water resource project in the field.

- 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 different factors and components of hydrology
- CO-2 Design water distribution system.
- CO-3 Design different types of irrigation system.
- CO-4 Develop drainage system
- CO-5 Select wells as per the requirement
- CO-6 Select pumps as per requirement

- 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	1	-	2	-	3	1		
CO-3	3	2	2	2	1	-	1		
CO-4	3	2	2	2	2	-	-		
CO-5	3	2	1	2	1	-	1		
CO-6	3	2	-	2	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				
2411404	Water Resources Management and Pumps	03	-	04	02	09	06

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)	
2411404	Water Resources Management and Pumps	30	70	20	30	20	30	200

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, microprojects, industrial visits, self-learning, any other student activities etc.)

Note:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2411404

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
<p><i>TSO.1a</i> Explain components of hydrologic cycle</p> <p><i>TSO.1b</i> Compute precipitation and evapotranspiration by different methods for the given situation</p> <p><i>TSO.1c</i> Measure and compute interception and infiltration</p> <p><i>TSO.1d</i> Analysis of point rainfall and its intensity, frequency and duration</p> <p><i>TSO.1e</i> Interpret the given rainfall chart and rating curve</p> <p><i>TSO.1f</i> Calculate peak flow for the given situation</p> <p><i>TSO.1g</i> Calculate peak runoff rate and volume with using different methods.</p> <p><i>TSO.1h</i> Measure steam flow.</p> <p><i>TSO.1i</i> Draw unit hydrograph of different durations and exercise on base flow separation for obtaining direct runoff hydrograph</p>	<p>Unit-1.0 Hydrology</p> <p>1.1 Introduction to Hydrology – Definition, Hydrologic cycle, Concept, Scope and Importance</p> <p>1.2 Precipitation: forms and types, Evaporation, Transpiration and evapo-transpiration: estimation and measurement, Consumptives use of water, interception, Infiltration, Run off, Mean aerial depth of precipitation</p> <p>1.1 Measurement of rainfall by Arithmetic average method, Thiessen polygon method, Isohytel method, nalysis of rainfall chart, estimation of missing data & adjustment of recor, mass curve, frequency analysis of point rainfall, plotting position and test for consistency of rainfall records.</p> <p>1.2 Factor effecting run off & its measurement, Rainfall - runoff relationship, Hydrograph, unit hydrograph factors affecting, measurement; stage and velocity, rating curve, hydrograph; components, base flow separation, unit hydrograph theory - unit hydrograph of different durations, uses and limitations of unit hydrograph</p> <p>1.3 Calculation of peak runoff rate and volume; rational method, Cook’s method, SCS-Curve number method</p>	<p>CO1</p>
<p><i>TSO 2a.</i> Explain the function of various agencies associated with water resource Management</p> <p><i>TSO 2b.</i> Prepare water balance study report</p> <p><i>TSO 2c.</i> Analysis of hydro-meteorological data, canal release data, water uses and distribution data.</p> <p><i>TSO 2d.</i> Plan water distribution system</p> <p><i>TSO 2e.</i> Design water distribution system</p> <p><i>TSO 2f.</i> Asses and measure the water yield in the give situation</p> <p><i>TSO 2g.</i> Mesure flood in the given situation.</p> <p><i>TSO 2h.</i> Analyze the flood frequency in the given situation</p> <p><i>TSO 2i.</i> Explain flood measurement procedure using different methods</p>	<p>Unit-2.0 <u>Water Resources Management</u></p> <p>2.1 Scope of water resource management, water allocation and water scheduling problem, equitable manners of water management,</p> <p>2.2 Concept and importance of sustainable water resources management and development. Status of water resources of the state and nation. Interrelation of water resources with other natural resources and the environment. Issues of water quality and water pollution.</p> <p>2.3 Concept of environmental water management and Integrated Water Resources Management (IWRM),</p> <p>2.4 Necessity and Role of various agencies in water resource management</p> <p>2.5 Water yield assessment and measurement, flood measurement - flood frequency analysis, reservoir operation study, flood routing - graphical methods of reservoir flood routing, hydrology of dry land areas - drought and its classification,</p>	<p>CO2</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
	<p>2.6 Water resource planning – concept, preliminary study, feasibility study, detailed planning - water duty, canal design, water allocation and water scheduling problem, equitable manners of water management</p> <p>2.7 Concept of Think Globally: Act Locally on water resources, Environmental discourse on dam construction, Crop production functions and irrigation optimization,</p>	
<p><i>TSO 3a.</i> Classify canals based on their functions.</p> <p><i>TSO 3b.</i> Explain factors affecting canal alignment</p> <p><i>TSO 3c.</i> Explain purpose of distribution works</p> <p><i>TSO 3d.</i> Differentiate between barrage and weir by means of a diagram and given criteria</p> <p><i>TSO 3e.</i> Calculate the water requirements for micro irrigation in the selected area.</p> <p><i>TSO 3f.</i> Prepare a layout and design micro-irrigation system for the given system</p> <p><i>TSO 3g.</i> Design drip irrigation system.</p> <p><i>TSO 3h.</i> Design sprinkle irrigation system</p> <p><i>TSO 3i.</i> Calculate irrigation period, irrigation interval and uniformity coefficient of given irrigation system.</p> <p><i>TSO 3j.</i> Case studies on advancement of water front in border, check basin and furrow method of irrigation with stream discharge and time.</p> <p><i>TSO 3k.</i> Case studies on different irrigation efficiencies in surface method of irrigation.</p>	<p>Unit-3.0 Irrigation System</p> <p>3.1 Definition, Necessity and principle of irrigation, Methods of irrigation & Irrigation efficiencies</p> <p>3.2 Monitoring of crop water stress and soil moisture, water uptake and release in the atmosphere and root zone, consumptive use determination from field and Lysimetric experiments</p> <p>3.3 Approaches of estimating reference crop evapotranspiration, crop coefficient, Effective rainfall, net irrigation requirement, gross irrigation requirement, project irrigation requirement, preparation of water demand sheet</p> <p>3.4 Crop growth stages, soil moisture depletion, miscellaneous uses of irrigation</p> <p>3.5 Types of irrigation-border, check basin, furrow and sprinkler and drip irrigation and their design and layout, repair and maintenance, their suitability, merits and limitations</p> <p>3.6 Components and working of different kinds of sprinkler irrigation and drip irrigation system, design and layout, repair and maintenance</p> <p>3.7 Micro-irrigation Systems, Operation and Maintenance of Micro Irrigation Systems, Advances in Micro-irrigation Systems</p> <p>3.8 Evaluation of irrigation performance, Automation in irrigation</p> <p>3.9 Command area and canal network: Conveyance and measurement of irrigation water, Different kinds of losses in canal system, Measurement of discharge through different types of weirs, V-notches and flumes</p>	<p>CO2</p>
<p><i>TSO.4a</i> Design surface drainage system for the given situation</p> <p><i>TSO.4b</i> Design subsurface drainage system for the given situation</p> <p><i>TSO.4c</i> Identify Drainage problem of the specific area and suggest remedial measures.</p> <p><i>TSO.4d</i> Explain the causes, effects & prevention of water logging</p> <p><i>TSO.4e</i> Prepare a plan for installation of drains and drain structures for the given situation.</p> <p><i>TSO.4f</i> Select different components of drainage system as per the need.</p>	<p>Unit-4.0 Drainage System</p> <p>4.1 Water logging definition effect & cause, anti-water logging measures, objectives of drainage system and drainage problems of the state.</p> <p>4.2 Subsurface drainage and its purpose, Types of surface drainage system, uses and benefits, drainage coefficient and design of open channel Investigations of design parameters, hydraulic conductivity, drainable porosity, water table etc.</p> <p>4.3 Concept of interceptor and relief drains, Derivation of ellipse (Hooghoudt's) and Ernst's drain spacing equation</p>	<p>CO4</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
<p><i>TSO.4g</i> Explain different types of drainage system.</p> <p><i>TSO.4h</i> Investigate different design parameters to design open channel for the given situation.</p> <p><i>TSO.4i</i> Derive the given equations</p> <p><i>TSO.4j</i> Cost analysis of surface and sub-surface drainage system.</p>	<p>4.4 Different types of drainage materials, drainage pipes, drain envelope. Layout, construction and installation of drains, drainage structures.</p> <p>4.5 Types of drainage system- vertical drainage, bio-drainage, tile drains. Salt balance, reclamation of saline and alkaline soils</p> <p>4.6 Drainage of irrigated and humid areas. Drainage of slopy and flat land. Leaching requirements, conjunctive use of fresh and saline waters. Economic aspects of drainage</p>	
<p><i>TSO 5a.</i> Identify various sources of water</p> <p><i>TSO 5b.</i> Describe various terms related to “ground water”</p> <p><i>TSO 5c.</i> Explain various types of wells with their features.</p> <p><i>TSO 5d.</i> Explain necessity of recharging ground water.</p> <p><i>TSO 5e.</i> Describe various methods of recharging ground water</p> <p><i>TSO 5f.</i> Suggest treatment for water problems for the given sample.</p> <p><i>TSO 5g.</i> Describe the reasons for groundwater quality contamination.</p> <p><i>TSO 5h.</i> Describe the methods to purify the effluent and wastewater used for agricultural purpose.</p> <p><i>TSO 5i.</i> Differentiate between different types of well.</p> <p><i>TSO 5j.</i> Explain the different methods of Indigenous water lifts.</p> <p><i>TSO 5k.</i> prepare of iso-bath and iso-bar maps</p>	<p>Unit-5.0 Irrigation Wells</p> <p>5.1 Sources of water-Importance of ground water and present scenario, terms related to groundwater- Aquifer, Aquiclude, Aquifuge, Aquitard, porosity, Specific yield, Specific retention, storage coefficient, coefficient of permeability, coefficient of transmissibility, Yield, specific yield</p> <p>5.2 Types of well-Open, Tube and flowing well, concept, location and importance</p> <ul style="list-style-type: none"> • Bore wells/Tube wells- types of tube wells-based on method of construction of tube wells • Open wells- open wells in unconsolidated formation, unlined wells, wells with previous lining, wells with impervious lining of open wells • Dug-cum bore wells- Construction details of wells. • Limitations advantages and disadvantages of tube wells and open wells. <p>5.3 Indigenous water lifts-different types, working of Indigenous water lifting devices.</p> <p>5.4 Water quality testing, classification, treatment and management, groundwater quality contamination, effluent and wastewater use in agriculture</p> <p>5.5 Necessity of recharging, artificial recharging, types of artificial recharge- spreading method, pit method / khet-talavadi, induced recharge method, recharge well method, sub-surface dam, check dam series, ponds, unlined canals</p>	CO5
<p><i>TSO 6a.</i> Explain various types of pumps used in residential, agricultural and commercial setups.</p> <p><i>TSO 6b.</i> Describe the performance measures, applications and properties of water pumps.</p> <p><i>TSO 6c.</i> Interpret the common terminologies used in pump systems.</p> <p><i>TSO 6d.</i> Explain various components of pump systems and related equipment.</p> <p><i>TSO 6e.</i> Select pump as per the requirement</p> <p><i>TSO 6f.</i> Analyze the effect of speed, head and power, change of impeller dimensions on performance characteristics and</p>	<p>Unit-6.0 Irrigation Pumps</p> <p>6.1 Types of pumps – classification, principle and working of pumping, Positive displacement and variable displacement pumps,</p> <p>6.2 Components, principles and working of a centrifugal pump and reciprocating pump Total pumping head, NPSH, maximum suction lift, power requirement in pumping.</p> <p>6.3 Concept of performance curves, priming, pump selection, installation and troubleshooting of centrifugal pumps. effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics and</p>	CO6

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
<p>accessories of centrifugal pumps.</p> <p><i>TSO 6g.</i> Differentiate between different types of pumps.</p> <p><i>TSO 6h.</i> State the types of water supply and their implication on pumping system.</p> <p><i>TSO 6i.</i> Explain the importance of referring to the manufacturers' specifications and standard Operating Procedures (SOPs) related to the installation and fitting of pumps</p> <p><i>TSO 6j.</i> Explain the procedure of installation, maintenance and troubleshooting of the given pumps.</p> <p><i>TSO 6k.</i> Select relevant pump for the given purpose.</p> <p><i>TSO 6l.</i> Prepare maintenance plan of local ground water source and water quality monitoring at water supply stations</p> <p><i>TSO 6m.</i> Prepare Maintenance plan of water distribution and storage systems at water supply station</p> <p><i>TSO 6n.</i> Optimize resource utilization at the workplace</p> <p><i>TSO 6o.</i> Graphical representation of the performance of centrifugal pump under different head-discharge condition</p>	<p>accessories of centrifugal pumps.</p> <p>6.4 Multistage pumps, deep well turbine and submersible pumps, mixed flow pumps, propeller pumps, axial flow pumps, jet and air lift pumps.</p> <p>6.5 manufacturers' specifications and standard Operating Procedures (SOPs) related to the installation and fitting of pumps</p>	

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2411404

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Use recording and non-recording type rain gauge	1.	Measure rainfall and estimate average depth of rainfall using recording and non-recording type rain gauge	CO1
<i>LSO 1.2.</i> Determine average depth of rainfall	2.	Determine average depth of rainfall over an area by Arithmetic mean method, Thiessen polygon method and isohyetal method	CO1
<i>LSO 2.1.</i> Analyze hydro-meteorological data, canal release data, water uses and distribution data.	3.	Perform water balance study of a catchment and associated command area.	CO2
<i>LSO 2.2.</i> Use pan evaporimeter	4.	Determine evaporation volume using pan evaporimeter	CO2
<i>LSO 2.3.</i> Develop water distribution system.	5.	Prepare plan and design water distribution system in a command area	CO2
<i>LSO 2.4.</i> Determine water requirement of crops	6.	Determine consumptive use and water requirement of crops in a command area	CO2
<i>LSO 3.1.</i> Install, test and use irrigation system	7.	Install micro-irrigation system	CO3
	8.	Test micro-irrigation system after the installation is complete	CO3
	9.	Install sprinkle irrigation system	CO3
	10.	Test Performance of sprinkler irrigation under different soil, crop and wind condition.	CO3
	11.	Install drip irrigation system	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
	12.	Test Performance of drip irrigation under different operating pressures.	CO3
LSO 3.2. Use basin and furrow method of irrigation	13.	Test basin and furrow method of irrigation with stream discharge and time.	CO3
LSO 3.3. Determination the given factors from field and Lysimetric experiments	14.	Determine crop water stress and soil moisture, water uptake and release in the atmosphere and root zone, consumptive use	CO3
LSO 4.1. Measure hydraulic conductivity and drainable porosity	15.	Measure hydraulic conductivity and drainable porosity of given soil sample.	CO4
LSO 4.2. Determine drainage coefficient	16.	Determine drainage coefficient.	CO4
LSO 4.3. Install sub-surface drainage system	17.	Fabricate and test drainage tiles and installation of sub-surface drainage system.	CO4
LSO 4.4. Determine Chemical properties of soil and water	18.	Determine chemical properties of given sample of soil and water	CO4
LSO 5.1. Collect data of observation well	19.	Collect pre & post monsoon water table data of observation well	CO5
LSO 5.2. Install piezometer and observation well	20.	Install piezometer and observation well.	CO5
LSO 5.3. Test the quality of water	21.	Test the quality of the given water samples.	CO5
LSO 6.1. Determine the performance of centrifugal pump	22.	Determine the performance of centrifugal pump under different operating head condition.	CO6
LSO 6.2. Determine the performance of a multistage submersible pump	23.	Determine the performance of a multistage submersible pump.	CO6
LSO 6.3. Install pump systems	24.	Install pump systems and related equipment	CO6
LSO 6.4. Operate and maintain pumping machinery	25.	Operate pumping machinery	CO6
LSO 6.5. Dismantle and assemble given pump	26.	Dismantle and assemble submersible pump	CO6
	27.	Dismantle and assemble pump components and equipment	CO6
	28.	Troubleshoot the given pump	CO6
LSO 6.6. Maintain <u>water treatment</u> units	29.	Operate and maintain <u>water treatment</u> units	CO6

L) **Suggested Term Work and Self Learning: S2411404** 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.

- i. Draw hydrograph from the streamflow and apply base flow separation technique to get direct runoff hydrograph
- ii. Assessment of water resource potential of nation and state
- iii. Prepare a detailed project report (DPR) for design and layout of drip and sprinkler irrigation system of nearby farm.
- iv. Prepare a detailed project report (DPR) for design and layout of drainage system of nearby farm.
- v. Prepare a report based on your experience with troubles, remedies and maintenance while dismantling, assembling and installing a centrifugal and a submersible pump.

b. **Micro Projects:**

- i. Using gauge-discharge/stream flow data of a river/rivelet in a watershed, prepare hydrograph followed by base flow separation and preparation of unit hydrograph of different durations.

- ii. Using one truck sand, prepare a 3D model of a command area, show cropping pattern, install/construct appropriate irrigation structures in a suitable site as per the guidelines. (Group Task). Once completed lets dismantle everything and repeat with new ideas. Now, try completing in at the earliest possible time.
- iii. Prepare a micro irrigation park showcasing different components and types of drip and micro sprinklers used in irrigation.
- iv. Prepare a micro water pumping park, showcasing different types of water pumping devices and pumps.

c. Other Activities:

1. Seminar Topics:

- Hydrology of small watershed
- Role of Agricultural Engineers in sustaining the Hydrology.
- Engineering interventions for boosting the water resources of the state
- Engineering interventions for enhancing the efficiencies of irrigation and drainage projects of the state.
- Water pumping: Then, now and the future

2. Visits:

- Field visit nearby command area of an irrigation projects and visualize the network of canals through which water reaches into the farmers field.
- Field visit nearby farmers field with installed modern methods of irrigation (Pumping systems) and a simple practicing drip irrigation system. Observe the difference of application and sophistication.
- Field visit nearby farmers field and observe the drainage system followed.
- ONLINE visit of the suggested you tube channels for innovative idea that could be implemented.

3. Self-Learning Topics:

- Concept of water budgeting and assessment of water resources of university farm.
- Low cost materials for irrigation in marginal farmers field
- Innovative water pumping implementable with little know how in farmers filed.
- Innovative and judicious applications of solar pump sets.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

Cos	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	15%	15%	15%	15%
CO-2	10%	15%	15%	15%	15%	15%	15%
CO-3	15%	15%	15%	15%	15%	15%	15%
CO-4	20%	20%	15%	15%	15%	15%	15%
CO-5	20%	15%	20%	20%	20%	20%	20%
CO-6	20%	20%	20%	20%	20%	20%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Hydrology	8	CO1	11	4	4	3
Unit-2.0 <u>Water Resources Management</u>	8	CO2	12	4	4	4
Unit-3.0 Irrigation System	8	CO3	12	3	4	5
Unit-4.0 Drainage System	8	CO4	12	3	4	5
Unit-5.0 Irrigation Wells	8	CO5	11	3	4	4
Unit-6.0 Irrigation pumps	8	CO6	12	3	4	5
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Measure rainfall and estimate average depth of rainfall using recording and non-recording type rain gauge	CO1	40	50	10
2.	Determine average depth of rainfall over an area by Arithmetic mean method, Thiessen polygon method and isohyetal method	CO1	60	30	10
3.	Perform water balance study of a catchment and associated command area.	CO2	60	30	10
4.	Determine evaporation volume using pan evaporimeter	CO2	60	30	10
5.	Prepare plan and design water distribution system in a command area	CO2	50	40	10
6.	Determine consumptive use and water requirement of crops in a command area	CO2	50	40	10
7.	Install micro-irrigation system	CO3	50	40	10
8.	Test micro-irrigation system after the installation is complete	CO3	50	40	10
9.	Install sprinkle irrigation system	CO3	30	60	10
10.	Test Performance of sprinkler irrigation under different soil, crop and wind condition.	CO3	30	60	10
11.	Install drip irrigation system	CO3	50	40	10
12.	Test Performance of drip irrigation under different operating pressures.	CO3	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Test basin and furrow method of irrigation with stream discharge and time.	CO3	50	40	10
14.	Determine crop water stress and soil moisture, water uptake and release in the atmosphere and root zone, consumptive use	CO3	50	40	10
15.	Measure hydraulic conductivity and drainable porosity of given soil sample.	CO4	50	40	10
16.	Determine drainage coefficient.	CO4	50	40	10
17.	Fabricate and test drainage tiles and installation of sub-surface drainage system.	CO4	50	40	10
18.	Determine chemical properties of given sample of soil and water	CO4	50	40	10
19.	Collect pre & post monsoon water table data of observation well	CO5	50	40	10
20.	Install piezometer and observation well.	CO5	50	40	10
21.	Test the quality of the given water samples.	CO5	50	40	10
22.	Determine the performance of centrifugal pump under different operating head condition.	CO6	50	40	10
	Determine the performance of a multistage submersible pump.	CO6	50	40	10
	Install pump systems and related equipment	CO6	50	40	10
23.	Operate pumping machinery	CO6	50	40	10
24.	Dismantle and assemble submersible pump	CO6	50	40	10
25.	Dismantle and assemble pump components and equipment	CO6	50	40	10
26.	Troubleshoot the given pump	CO6	50	40	10
27.	Operate and maintain water treatment units	CO6	50	40	10
28.	Operate pumping machinery	CO6	50	40	10
29.	Dismantle and assemble submersible pump	CO6	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Personal Computer, Laptops	Operating System: Windows 11, Windows 10 (version 20H2 or higher), Windows Server 2019 or Windows Server 2022 Processor: Minimum: Any Intel or AMD x86-64 processor Recommended: Any Intel or AMD x86-64 processor with four logical cores and AVX2 instruction set support RAM: Minimum: 4 GB Recommended: 8 GB Storage: Minimum 512 GB Graphics: No specific graphics card is required, but a hardware accelerated graphics card supporting OpenGL 3.3 with 1GB GPU memory is recommended.	All
2.	Map Scanner / Plotter	Scanning Area: Around 22 inches by 30 inches Resolution: Typically in the range of 600 dpi (dots per inch) or higher for clear and detailed scanning of toposheets.	All
3.	Climatological and hydrological data	IMD data, Gauge-discharge data, Gridded data, NASA Power data	1, 2 and 3
4.	Land use, Land cover, climatological and hydrological data	District irrigation profile data, district statistical data, state at a glance	1,2,3
5.	State of the art drip irrigation and fertigation system	Latest drip irrigation system of renowned companies for demonstration as well as familiarization and data generation	11,12
6.	State of the art sprinkler irrigation and fertigation system	Latest sprinkler irrigation system of renowned companies for demonstration as well as familiarization and data generation	10,9
7.	Flow measuring devices, stop watch, stakes, tools for working and levelling soil	Latest flow measuring devices, viz. V-notch, rectangular weir, trapezoidal weir, H-flume, Parshall Flume,	All
7.	3-D Models of different structures like turn out, hydrant, sluice gate, mole plough, centrifugal pump, submersible pump and other water lifting devices etc.	Proportionate model	22 to 29
8.	Piezometer, observation well, drainage tiles	Standard piezometer and observation well Drainage tiles of different materials	17,20
9.	Centrifugal pumps, Submersible pumps, Turbine pumps, mixed flow, propeller pumps and other water lifting devices	AC as well DC pumps, 8 watt DC submersible pumps to 5 hp AC pumps, Solar pump sets, Low head high discharge to high head low discharge pumps.	22 to 29
10.	Auto Level	Bright and sharp view, reduced operator's eye strain, quick collimation, horizontal angle measurement, fast and easy aiming, Leveling Accuracy: $\pm 0.7\text{mm}$ to $\pm 2.0\text{mm}$, Telescope Magnification: 24x to 32x, Minimum focus distance: 0.2m from end of telescope, 0.3m from center, dust tight and water tight protection, Precise: Reliable Automatic Compensator	

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Land and Water Management Engineering	VVN Murty and Madan K. Jha	Kalyani Publishers, 6 th ed, 2013, ISBN-13: 978-9327214659
2.	Water and Air Effluents Treatment Handbook	NPCS Board of Consultants & Engineers	Asia Pacific Business Press Inc. ISBN-13 : 978-8178331195
3.	Principles of Agricultural Engineering (Vol.-1)	by A.M. Michael T.P. Ojha	Science technology- Jain Brothers; 14 th Ed.,2021 ASIN : B09Q1CSQQ7
4.	Principles of Agricultural Engineering Vol-2	A.M. Michael, T.P. Ojha	Jain Brothers, 6th Edition,2013 ISBN : 9788183601849
5.	Irrigation and Drainage Engineering	Svenja Breisacher (Editor)	Scitus Academics LLC , 2018 ISBN-13 : 978-1681179131
6.	Hydrology and Soil Conservation Engineering: Including Watershed Management	Ghanshyam Das	Prentice-Hall of India Learning Pvt. Ltd., 2nd Ed., 2009 ISBN-13, 978-8120335868
7.	An Introduction to Water Well Pumps for Professional Engineers	by J. Paul Guyer	Kindle Edition, 2022 ASIN : B0BMM5MS15
8.	Water, Well & Pump Engineering	Michael AM and Khepar ST	Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992 ISBN-13 : 978-0074517857
9.	Irrigation Theory and Practice	Micheal AM	S Chand; Second edition, 2008 ISBN-13 : 978-8125918677
10.	Micro-Irrigation Theory & Practice	R Suresh	Standard Publishers Distributors, 2009 ISBN-13 : 978-8180141508
11.	Ground Water Hydrology.	David K. Todd Larry W. Mays	Wiley Intern. Edition. Toppan Company Ltd, Tokyo. 2011 ISBN-13 : 978-8126530038

(b) Online Educational Resources:

1. https://youtu.be/_52-gzf4zh8
2. <https://youtu.be/pXCftqj1g1A>
3. <https://youtu.be/RhbU1pyXWFo>
4. <https://youtu.be/iObNAERBkE8>
5. <https://youtu.be/hv1y8hVHpiU>
6. ICAR lecture series 'Basics of Irrigation" Dr Jitendra Sinha

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others: Low cost, cost effective and environment friendly ideas that could be applied in water resources management and pumps

- 1) <https://youtu.be/INpKjdX2oIw>
- 2) <https://youtu.be/n5O2ERQGfA>
- 3) <https://youtu.be/U-zaycBwi7U>
- 4) <https://youtu.be/GF9Q2EfqGnA>
- 5) <https://youtu.be/TzBvbZFsEbl>
- 6) <https://youtu.be/tFACtN53yD8>

- A) **Course Code** :2411405(T2411405/S2411405)
 B) **Course Title** : Soil and Water Conservation
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Soil and water are fundamental resources for agriculture, providing the foundation for crop production and ensuring food security. Understanding the principles and practices of soil and water conservation is crucial for sustainable agriculture and maintaining the long-term productivity of agricultural lands. This conservation measures aim to minimize negative impacts like soil degradation, erosion, water pollution, and loss of biodiversity, preserving soil fertility, natural resources and mitigating environmental degradation. This course motivates agricultural engineers contribute to the long-term sustainability of agricultural systems along with mitigation of the costs associated with environmental degradation being a part of government agencies, private companies, and non-profit organizations.

- 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 top Soil Properties for its agricultural purposes

CO-2 Take measures for Erosion Control and Soil Conservation

CO-3 Apply techniques such as contours and bunds for maintaining typical soils for farming/agriculture

CO-4 Analyze hydrological parameters for runoff measurement applicable in agri. Engineering.

CO-5 Use watershed technologies for conservation of water for agriculture purposes

- 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	3	2	1	-	-
CO-2	3	2	1	2	2	-	2	-	-
CO-3	2	2	2	-	2	1	1	-	-
CO-4	-	1	1	2	1	2	1	-	-
CO-5	2	-	-	3	2	1	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:**

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				
2411405	Soil and Water Conservation	02	01	-	02	05	04

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)	
2411405	Soil and Water Conservation	30	70	20	30	-	-	150

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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2411405

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Analyze the soils for its properties applicable to the agriculture</p> <p><i>TSO 1b.</i> Explain the basic purpose of soil conservation</p> <p><i>TSO 1c.</i> Analyze soils for its seepage and permeability characteristics</p>	<p>Unit-1.0 Introduction to Top Soil</p> <p>1.1 Engineering properties of soils</p> <p>1.2 Relevance of soil and water conservation in agriculture</p> <p>1.3 Index properties of soils</p> <p>1.4 Permeability and seepage analysis.</p>	CO1
<p><i>TSO 2a.</i> Explain common factors and causes of soil erosion</p> <p><i>TSO 2b.</i> Describe the universal soil loss equation</p> <p><i>TSO 2c.</i> Explain the stages of development of gullies</p> <p><i>TSO 2d.</i> Classify the soil erosion</p> <p><i>TSO 2e.</i> Estimate the loss due to soil erosion.</p>	<p>Unit-2.0 Soil and Water Erosion</p> <p>2.1 Mechanics of soil erosion</p> <p>2.2 Wind and water erosion</p> <p>2.3 Soil erosion: Types, agents, factors affecting and loss estimation</p> <p>2.4 Universal soil loss equation (USLE) and modified USLE</p> <p>2.5 Gullies - Classification, stages of development</p>	CO2
<p><i>TSO 3a.</i> Explain the application of contour in farming</p> <p><i>TSO 3b.</i> Explain the purposes of Bunds and terrace farming</p> <p><i>TSO 3c.</i> Prepare a plan for the given Bunds and terrace layout</p> <p><i>TSO 3d.</i> Design required vegetative and Grassed waterways.</p> <p><i>TSO 3a.</i> Develop Gully control structure</p>	<p>Unit-3.0 Agronomical and Engineering Measures to Control Erosion</p> <p>3.1 Contour farming, strip cropping, conservation tillage and mulching</p> <p>3.2 Bunds and terraces: Contour, planning, designing and layout procedure</p> <p>3.3 Vegetative waterways & Gully control structures</p> <p>3.4 Grassed waterways and design</p>	CO3
<p><i>TSO 4a.</i> Explain hydrological cycle of rain.</p> <p><i>TSO 4b.</i> Measure typical metrological parameters applicable for Agri, purposes</p> <p><i>TSO 4c.</i> Analyze runoff data for soil conservation design</p> <p><i>TSO 4d.</i> Measure stream flow for soil conservation point of view</p>	<p>Unit-4.0 Hydrology</p> <p>4.1 Hydrological cycle and measurement of its components</p> <p>4.2 Meteorological parameters and their measurement</p> <p>4.3 Analysis of data: runoff estimation</p> <p>4.4 Hydrograph theory and application</p> <p>4.5 Streamflow measurement & Infiltration</p>	CO4
<p><i>TSO 5a.</i> Describe watershed management techniques and characteristics</p> <p><i>TSO 5b.</i> Develop rain water harvesting for using water for agriculture</p> <p><i>TSO 5c.</i> Calculate silt sedimentation and storage losses</p> <p><i>TSO 5d.</i> Use water for other than agri. Application</p>	<p>Unit-5.0 Watershed Management</p> <p>5.1 Watershed: Definition, delineation and management</p> <p>5.2 Watershed characterization and land use capability classification</p> <p>5.3 Rainwater harvesting: check dams and farm ponds</p> <p>5.4 Rate of sedimentation, silt monitoring and storage loss in tanks</p> <p>5.5 Alternate use of the stored water for agriculture</p> <p>5.6 Environmental Protection Act</p>	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)

L) **Suggested Term Work and Self Learning: S2411405** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Prepare a report describing the different types, plan and design of integrated soil and water conservation practices used in rural areas.
- ii. Prepare action plan of integrated soil and water conservation practices at state level.

b. Micro Projects:

- i. Design and implement soil and water conservation plan for a given agricultural area
- ii. Analyze the effect of different Meteorological parameters on different types of farming
- iii. Design plan for rain water harvesting for the given area.

c. Other Activities:

1. Seminar Topics:

- iii. Software's for design of soil conservation structures.
- iv. Applications of Remote Sensing and GIS in Soil and Water Conservation.

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	20%	-	20%	-	-
CO-2	20%	20%	20%	25%	20%	-	-
CO-3	30%	30%	20%	25%	20%	-	-
CO-4	20%	20%	20%	25%	20%	-	--
CO-5	15%	15%	20%	25%	20%	-	--
Total Marks	30	70	20	20	10	-	-
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

- N) Suggested Specification Table for End Semester Theory Assessment:** Specification table represents the reflection of sample representation of assessment of cognitive domain of full course for progressive assessment.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Top Soil	8	CO1	10	2	3	5
Unit-2.0 Soil and Water Erosion	10	CO2	15	8	3	4
Unit-3.0 Agronomical and Engineering Measures to Control Erosion	12	CO3	20	4	6	10
Unit-4.0 Hydrology	8	CO4	13	2	4	7
Unit-5.0 Watershed Management	10	CO5	12	4	4	4
Total	48	-	70	20	20	30

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

- O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)**

- P) Suggested Instructional/Implementation Strategies:** Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

- Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)**

- R) Suggested Learning Resources:**

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Soil and Water Conservation Engineering	Glenn O. Schwab, Delmar D. Fangmeier, William J. Elliot Richard K. Frevert	John Wiley & Sons, 1993 ISBN-10: 0471574902 ISBN-13: 978-0471574903
2.	Soil Conservation	N. Hudson	Publisher: Cornell University Press 2015 ISBN-10: 0801493439 ISBN-13: 978-0801493430
3.	Soil and Water Conservation Engineering	R. Suresh	Standard Publishers and Distributors Pvt Ltd, 2020, ISBN-10: 8180141861 ISBN-13: 978-8180141867
4.	Land and Water Management Engineering	Madan K. Jha V.V.N. Murty	Kalyani Publishers, 2013 ISBN-10: 932721465X ISBN-13: 978-9327214659
5.	Land and Water Management Engineering	Mangal Adagounda Patil Arun Dattatray Bhagat	Jain Brothers; 3rd Edition, 2023 ISBN: 9971460108, ASIN : B0CVF9L4BK

(b) Online Educational Resources:

- Soil and Water conservation
URL: <https://archive.nptel.ac.in/courses/126/105/126105012/>
- Introduction to Soil and Water Conservation Engineering
URL: <http://www.jnkvv.org/PDF/05042020172047Soil-5.pdf>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others: -

- A) **Course Code** : 2400007(T2400007)
 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				
2400007	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)	
2400007	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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2400007

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.
5. Prepare collage/posters on current constitutional issues.
 - Emergencies declared in India
 - Seven fundamental rights

6. Cases: Suggestive cases for usage in teaching:

Case	Relevance
A.K. Gopalan Case (1950)	SC contended that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.
Shankari Prasad Case (1951)	This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980)	This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978)	A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."

7. Self-Learning Topics:

- Parts of the constitution and a brief discussion of each part.
- Right to education.
- Right to equality.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	30%	-	30%	-	-	-	-
CO-2	40%	-	40%	50%	50%	-	-
CO-3	30%	-	30%	50%	50%	-	-
Total Marks	25	-	5	10	10	-	-
			25				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The Constitution of India	P.M. Bakshi	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105
2.	Introduction to Indian Constitution	D.D. Basu	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3.	Introduction to Constitution of India	B. K. Sharma	PHI, New Delhi, 6th edition, 2011, ISBN:8120344197
4.	The Constitution of India	B.L. Fadia	Sahitya Bhawan, Agra, 2017, ISBN:8193413768
5.	The Constitutional Law of India	Durga Das Basu	LexisNexis Butterworths Wadhwa, Nagpur 978-81-8038-426-4

(b) Online Educational Resources:

- <https://www.coursera.org/learn/principles-of-management>
- <http://www.legislative.gov.in/constitution-of-india>
- https://en.wikipedia.org/wiki/Constitution_of_India
- <https://www.india.gov.in/my-government/constitution-india>
- <https://eci.gov.in/about/about-eci/the-setup-r1/>
- <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>
- <https://main.sci.gov.in/constitution>
- <https://nios.ac.in/media/documents/srsec317newE/317EL8.pdf>
- <https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf>
- https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm
- <https://constitutionnet.org/vl/item/basic-structure-indian-constitution>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

- A) **Course Code** : **2400107(T2400107)**
 B) **Course Title** : Professional Ethics
 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/ 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	3	3	3	3	3		
CO-2	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:**

	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

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) 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.

I) Theory Session Outcomes (TSOs) and Units: T2400107

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Define concepts-values and ethics and attitude, development of attitudes</p> <p><i>TSO 1b.</i> Identify situations depicting values such as humanity, honesty, punctuality, respect, peace, empathy</p> <p><i>TSO 1c.</i> Identify situations depicting ethics, healthy competition, integrity, truthfulness,</p>	<p>Unit-1.0 Values and Ethics in Day to Day Life</p> <p>1.1. Values- Definition and examples, Ethics- definition and examples, Concept of attitude and development of attitude</p> <p>1.2. Importance of values and ethics in day to day activities and at workplace- Ethical ways of communication, environmental considerations in engineering processes, Basic concept of Carbon footprint, ethics at workplace</p> <p>1.3. Examples of situations depicting values- based decisions and ethical behavior in day to Day life</p>	CO1
<p><i>TSO 2a.</i> Identify the relevance of profession to society and environment</p> <p><i>TSO 2b.</i> Identify the need of values and ethics in profession related activities</p> <p><i>TSO 2c.</i> Identify Ethical conflicts</p>	<p>Unit-2.0 Values and Ethics in Profession</p> <p>2.1 Relevance of profession to society</p> <p>2.2 ethical principles such as respecting others and ourselves, respecting the rights of others, keeping promises, avoiding unnecessary problems to others, avoiding cheating and dishonesty, showing gratitude towards others and encouraging them to work</p> <p>2.3 Identification of activities and related ethical and unethical behavior for professional activities in their area of work</p> <p>2.4 Examples of situations depicting values- based decisions and ethical behavior</p>	CO1, CO2

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

J) Suggested Activities and Self-Learning: Reading books related to values and ethics/Epics/ Daily news and discussions in group

a. Assignments: Preparation for group discussion, panel discussion, role play, case study, seminar, skits

- b. **Micro Projects:** Skits development and performance, poster making,
- c. **Activities: Role Play, Case studies, Debates, Group Discussion,**
- d. Suggested Seminar/ Debates on Topics such as:
- charters of professions
 - Importance of Values and ethics in identified profession
 - Issues of ethical conflicts- Professional rivalry,
 - Identified issues from Chanakya Neeti
 - Ethics in scriptures such as Kabir ke Dohe etc.
 - Lessons on ethics from religious scriptures
 - Issued based on Happenings reported in Daily news

K) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Case Method, Group Discussion, seminar, Role Play, Live Demonstrations in Classrooms, Lab, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

L) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

M) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Professional Ethics and Human Values	D. R. Kiran	McGraw-Hill Education Pvt. Ltd. 2007 ISBN: 9780070633872
2.	A Textbook On Professional Ethics And Human Values	Dr. R S Naagarazan	New Age International (P) Ltd., Publishers, 2017 ISBN: 9789386173768
3.	Ethics, Integrity and Aptitude – Hindi (Paperback) (□□□□□□, □□□□□□□□□□ □□□ □□□□□□□□)	P.D Sharma	Rawat Publications, 2019 ISBN: 978-8131609941
4	Chanakya - Niti (Sutra Sahit) (Hindi)	Chanakya	Maple Press. 2014 ISBN 978-9350335529

(b) Online Educational Resources:

- Free Ethics & Compliance Toolkit - Ethics and Compliance Initiative
(<https://www.ethics.org/resources/free-toolkit>)
- Free & open source tools for ethics practitioners (<https://www.cityethics.org/harvard-lab>)
- Microsoft Word - KPTI XII - Indian Ethics 03-05-13
(https://cbseacademic.nic.in/web_material/doc/ktpi/30_KPTI%20XII%20-%20Indian%20Ethics_old.pdf)
- Knowledge Traditions & Practices of India (cbseacademic.nic.in)
(ps://cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_5.pdf)

(c) Others: -
