

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 – II Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
2415201	BEC	Basic Surveying (CE, AE)	03	-	04	02	09	06
2411202	PCC	Agronomy and Horticulture crops and Plant Protection	03	-	04	02	09	06
2420103	BEC	Fundamentals of Electrical and Electronics Engg. (CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)	03	-	04	02	09	06
2425104	BEC	Engg. Mechanics (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	03	-	04	02	09	06
2411205	PCC	Green House Technologies	02	01	-	02	05	04
2400108	NRC	Essence of Indian Knowledge System and Tradition (Common for All Programmes)	01	-	-	-	01	01
2400111	NRC	Principles of Management (Non-exam course) (CE, AIML, AE, CHE, CSE, ME, ME (Auto), FTS, MIE)	01	-	-	-	01	01
Total			16	1	16	10	43	30

Note: Prefix will be added to Course Code if applicable (T for Theory, 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 - II 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)	
2415201	BEC	Basic Surveying (CE, AE)	30	70	20	30	20	30	200
2411202	PCC	Agronomy and Horticulture crops and Plant Protection	30	70	20	30	20	30	200
2420103	BEC	Fundamentals of Electrical and Electronics Engg. (CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)	30	70	20	30	20	30	200
2425104	BEC	Engg. Mechanics (CE, EE, ME, ME (Auto), MIE, FTS, AE, CRE, CHE, ELX, ELX (R), TE)	30	70	20	30	20	30	200
2411205	PCC	Green House Technologies	30	70	20	30	-	-	150
2400108	NRC	Essence of Indian Knowledge System and Tradition (Common for All Programmes)	25	-	-	-	-	-	25
2400111	NRC	Principles of Management (Non-exam course) (CE, AIML, AE, CHE, CSE, ME, ME (Auto), FTS, MIE)	25	-	-	-	-	-	25
Total			200	350	100	150	80	120	1000

Note: Prefix will be added to Course Code if applicable (T for Theory, 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** : 2415201(T2415201/P2415201/S2415201)
 B) **Course Title** : Basic Surveying (CE, AE)
 C) **Pre-requisite Course(s)** : Basic Geometry
 D) **Rationale** :

Surveying is the science and art of taking all necessary measurements to identify the relative location of points or physical and cultural elements above, on, or under the surface of the earth, and to display them in a useful manner. The theodolite, compass, auto-level, chains, tapes, levelling staff, total station, etc., are all essential surveying equipment. Surveying includes both: the time spent in the field and in the office. This is because all necessary distance, angle, direction, elevation, location, area, and volume measurements are obtained in the field and then calculated back at the office. Surveying is done to produce a map that depicts the relative locations of the various features on the earth's surface. The map is created to a scale that seems appropriate. This subject is essential for students to have information on the field and its topography to prepare maps or drawings; for any civil or architectural work. This course will help the students to get familiar with various surveying instruments and will help improve their understanding of the topography of the building site. This course will provide an opportunity to develop skills in surveying at the primary level. The data gathered from surveying helps establish planning and design to determine the best course of action. To understand the techniques of surveying, a student must carefully understand the use of various surveying instruments used in the field.

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

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

- CO-1** Undertake the relevant type of survey for the given purpose in the given situation.
CO-2 Apply the necessary correction to the linear measurements recorded in the field book.
CO-3 Conduct chain and compass traverse survey in the given field.
CO-4 Draw the contour map of the given terrain using the relevant levelling instrument in the given situation.
CO-5 Use a digital planimeter to measure the area of the given figure or shape.

- 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	-	2	1	1
CO-2	3	2		2	2	1	1	1	1
CO-3	3	3	2	2	3	2	1	1	1
CO-4	2	2	2	2	3	3	1	1	1
CO-5	2	2	2	1	-	3	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				
2415201	Basic Surveying	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)	
2415201	Basic Surveying	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: T2415201

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
<p>TSO1a. Propose the relevant type of survey in the given situation.</p> <p>TSO1b. Apply the basic principles of surveying in the given type of survey.</p> <p>TSO1c. Select the relevant scale for the given situation.</p>	<p>Unit-1.0 Overview and Classification of Survey</p> <p>1.1 Survey-Purpose and Use.</p> <p>1.2 Types of surveying- Primary and Secondary, Classification: Plane, Geodetic. Cadastral, Hydrographic, and Aerial.</p> <p>1.3 Principles of Surveying</p> <p>1.4 Scales: Engineer's scale, Representative Fraction (RF), diagonal scale, and Vernier Scale.</p>	CO1
<p>TSO2a. Draw the perpendicular offsets on the main chain line in the given situation.</p> <p>TSO2b. Conduct the chain survey to draw the plan of the given building structure.</p> <p>TSO 2c. Draw the schematic diagram showing the details such as the Baseline, check line, and Tie line including Main Survey Station.</p> <p>TSO2d. Use the relevant method of ranging in chain survey.</p> <p>TSO2e. Explain the type of error and correction required in the chain survey.</p> <p>TSO2f. Compute the area of a given field using the principle of triangulation.</p>	<p>Unit-2.0 Chain Survey</p> <p>2.1 Instruments used in chain survey: Metric Chain, Tapes, Arrow, ranging rod, Line ranger, Offset rod, Open cross-staff, Optical square.</p> <p>2.2 Chain survey Station, Baseline, Check line, Tie line, Offset, Tie Station.</p> <p>2.3 Ranging Direct and Indirect Ranging, Method of chaining, obstacles in chaining.</p> <p>2.4 Errors in length: Instrumental error, personal error, error due to natural cause, random error, Principles of triangulation.</p> <p>2.5 Types of offsets: Perpendicular and Oblique, Conventional Signs, Recording of measurements in a field book.</p>	CO2
<p>TSO3a. Perform the relevant Traverse for the given situation.</p> <p>TSO3b. Distinguish between True Meridian and Magnetic Meridian</p> <p>TSO 3c. Convert the whole circle bearing to a reduced bearing and vice versa.</p> <p>TSO 3d. Calculate the include angles of a closed traverse after applying suitable corrections.</p> <p>TSO 3e. Draw a labeled diagram of a Prismatic Compass.</p> <p>TSO 3f. Determine the correct bearing from The given</p>	<p>Unit-3.0 Compass Survey</p> <p>3.1 Compass Traversing-open, closed.</p> <p>3.2 Technical Terms: Geographic/True Meridians, Magnetic Meridians, and Bearings, Whole Circle Bearing system and Reduced Bearing system and examples on the conversion of given bearing to another bearing (from one form to another), Fore Bearing and Back Bearing, Calculation of internal and external angles from bearings at a station, Dip of Magnetic needle, Magnetic Declination.</p>	CO2, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Numbers
observed bearing. TSO 3g Adjust the closing error of the Traverse for the given data.	3.3 Components of Prismatic Compass and their functions, Methods of using Prismatic Compass- Temporary adjustments and observing bearings. 3.4 Local attraction, Methods of correction Of observed bearings - Correction at station and correction to included angles. Methods of plotting a traverse and closing error, Graphical adjustment of closing error	
TSO4a. Explain the given basic terms used in the levelling. TSO4b. Select the relevant levelling instrument for the given purpose. TSO4c. Explain the temporary adjustment of the dumpy level. TSO 4d. Calculate the Reduced Level of given point using Rise and Fall method. TSO 4e. Choose levelling operation for the given situation. TSO 4f Explain the Characteristics of the contour lines along with their uses. TSO 4g Recognize the nature of terrain from the given contour map.	Unit-4.0 Levelling and Contouring 4.1 Basic terminologies: Level surface, Horizontal and vertical surface, Datum, Bench Mark - Permanent, Temporary, Arbitrary. Reduced Level, Rise, Fall, Back sight, Foresight, Intermediate sight, Change point, Height of instrument, Line of collimation. 4.2 Types of levels: Dumpy, Tilting, and Auto level, Temporary adjustments of Level. 4.3 Types of Levelling Staff: Self-reading staff and Target staff, Reduction of level by Height of Instrument Method, and Rise and Fall Method. 4.4 Levelling Types: Simple, Differential, Fly, Profile, and Reciprocal Levelling. 4.5 Contour, contour intervals, horizontal equivalent, Uses of contour maps, Characteristics of contours, Methods of Contouring-Direct and indirect	CO4
TSO5a. Draw the labeled figure of the digital planimeter. TSO5b. Describe the Procedure of measuring a given Area with the help of a planimeter TSO 5c. Compute the volume of the reservoir using the given contour map.	Unit-5.0 3D Measurement of Area and Volume 5.1 Components and use of Digital planimeter. 5.2 Measurement of the area using a digital planimeter. 5.3 Measurement of the volume of the reservoir from the contour map.	CO4, CO5

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2415201

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO1.1. Perform ranging and chaining operations in different field conditions.	1.	Measure the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2
LSO2.1. Perform reciprocal ranging for the given situation.	2.	Perform reciprocal ranging and measure the distance between two stations.	CO2
LSO3.1. Determine the area of the given open field.	3.	Determine the area of open field using chain and cross staff survey.	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO4.1. Measure the fore bearing and back bearing of given survey lines using a Prismatic compass.	4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass.	CO2, CO3
LSO5.1. Measure fore bearing and back bearing of a closed traverse and after applying correction in the bearings, measure the included angle for the given situation.	5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction.	CO2, CO3
LSO6.1. Undertake Survey Project for the given situation.	6.	Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building.	CO2, CO3
LSO7.1. Plot a traverse on an A1 size imperial drawing sheet for the survey project.	7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3
LSO8.1. Undertake simple levelling operation for determining the reduced level of given points.	8.	Undertake simple levelling using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO9.1. Undertake differential levelling operation for determining the reduced level of given points.	9.	Undertake differential levelling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and levelling staff.	CO2, CO4
LSO10.1. Undertake fly levelling for the given situation.	10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4
LSO11.1. Undertake a survey project to plot a contour map for the given situation.	11.	Undertake Survey Project for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4
LSO12.1. Measure the area of the given irregular figure using a digital planimeter.	12.	Measure the area of the irregular figure using a Digital planimeter	CO5

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

(L) Suggested Term Work and Self Learning: S2415201 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.

1. Prepare and sketch a list of tools and equipment used in chain and tape survey.
2. Explain with diagram the use of optical square, prism square and cross staff.
3. Describe with the help of neat sketch prismatic compass and surveyors' compass.
4. Identify errors and their corrective measures in compass survey.
5. Explain local attraction in compass surveying.
6. Explain methods to detect and eliminate local attraction.
7. Describe dumpy level with neat sketch.
8. Describe with sketches the characteristics of contour.

b. Micro Projects:

1. Undertake an internet survey to collect information on survey instruments available in the market with specifications.
2. Carry out a comparative study of the following survey instruments of different make and brands: Auto level and Dumpy Level.
3. Measure the area of the municipal wards and the area of the city from the ward-wise map of the city using a digital planimeter.

4. Determine the Reduced Levels (RLs) of the existing structures like lintels, chajja, slab, and beam.
5. Download specifications for prismatic compass, dumpy level, auto level, and digital planimeter using the internet.
6. Perform a reconnaissance survey for alignment of the road.
7. Collect and interpret contour maps of different terrains available with various authorities.
8. Construct and measure the given length using a Diagonal scale from a given map.

c. **Other Activities:** Calculate the quantity of earthwork to construct the road with the help of levelling diagram.

1. **Seminar Topics:**

- Scales and their importance used in Surveying
- Local attraction in compass surveying
- Triangulation: A method of measuring the area of a given field
- Meridian and Bearings used in compass surveying
- Contours and Types of Terrain
- Digital Planimeter and Area Measurement
- How to conduct a survey and plot a map of the city

2. **Self-Learning Topics:**

- Classification of the survey based on the nature of the field and based on the object of the survey.
- Comparison between surveyor and prismatic compass.
- Study of variation of earth's magnetic field and Declination.
- Study of modern instruments used in leveling.
- Study of toposheets and calculate catchment areas

M) **Suggested Course Evaluation Matrix:** The course teacher has to decide and use the 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.

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 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 Overview and Classification of Survey	08	CO1	08	4	2	2
Unit-2.0 Chain Survey	10	CO1, CO2	14	4	6	4
Unit-3.0 Compass survey	12	CO3, CO4	14	4	6	4
Unit-4.0 Leveling and Contouring	14	CO3, CO4	14	6	4	4
Unit-5.0 Measurement of Area and Volume	04	CO4, CO5	20	2	10	8
Total Marks	48	-	70	20	28	22

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 the distance between two survey stations using chain, tape, and ranging rods when two stations are inter-visible.	CO1, CO2	30	60	10
2.	Perform reciprocal ranging and measure the distance between two stations.	CO2	40	50	10
3.	Determine the area of open field using chain and cross staff survey.	CO2	30	60	10
4.	Measure Fore Bearing and Back Bearing of survey lines of open traverse using Prismatic Compass	CO2, CO3	30	60	10
5.	Measure Fore Bearing and Back Bearing of a closed traverse of 5 or 6 sides and correct the bearings and included angles for the local attraction	CO2, CO3	30	60	10
6.	Undertake Survey Project with chain and compass for closed traverse for minimum 5 sides around a building	CO2, CO3	30	60	10
7.	Plot the traverse on an A1 size imperial drawing sheet for data collected in Survey Project mentioned at practical No.6	CO2, CO3	40	50	10
8.	Undertake simple leveling using dumpy level/ Auto level and leveling staff.	CO2, CO4	40	50	10
9.	Undertake differential leveling and determine Reduced Levels by Height of instrument method and Rise and fall method using dumpy level/Auto Level and leveling staff.	CO2, CO4	40	50	10
10.	Undertake fly levelling with a double check using dumpy level/ Auto level and levelling staff.	CO2, CO4	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
11.	Undertake Survey Project for plotting contour map using block contouring method for a block of 150m x 150m with a grid of 10m x10m.	CO2, CO4	30	60	10
12.	Measure the area of the irregular figure using a Digital planimeter	CO5	30	60	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	Steel Tapes 30 meter	Made of steel as per IS Specifications	1,2,3
2	Engineer's Chain	made of M.S. 100-foot survey chain with 100links solid brass handles &link	1,2,3
3	Metallic Tape 20 /30metre	Good quality	1,2,3
4	Ranging Rod Steel	Ranging Rod Steel 6' Length 2 Meter (Straight / Folding / Screw Type	1,2,3
5	Chain 30 meter	made of M.S. with 100 links and solid brass handles	1,2,3
6	Chain 20 meter	made of M.S. with 100 links and solid brass handles	1,2,3
7	Optical square Indian	Circular type, made of brass, fitted with double reflecting mirror right and left to 90 degree	1,2,3
8	Prismatic Compass	Made of Brass, Size 100mm dia. As Per I.S.I. Specification	4,5,6,7
9	Open type Cross staff	Size 4", Open Type having four vanes at right angles.	1, 4,5,6,7
10	Dumpy level 300 mm	Telescopic Length Size 12", Erect Image. Internal Focusing, Fitted with compass	8,9,10
11	Levelling staff 4 meter	Made of a Fully Aluminum body, telescopic type in Three sections .I.S.I. Specifications No IS:1779-1961	8,9,10
12	Tilting level	Size 178mm /7" Internal focusing, anti-reflection coated optics.	8,9,10
13	Planimeter	Standard	12

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

S. No	Titles	Author(s)	Publisher and Edition with ISBN
1	Surveying 1	Dr BC Punmia, Ashok Kumar Jain, Dr. Arun Kumar Jain	Laxmi publication, Seventeenth Edition ISBN-10 9788170088530, ISBN-13 978-8170088530
2	Surveying and Leveling	A K Arora	Standard book house, 17th edition ASIN : B08GY78N55 ISBN-13: 9788189401238
3	Surveying and Leveling	S K Duggal	TMG publication, 5th edition ISBN-10 : 9353167523 ISBN-13 : 978-8132110255
4	Surveying and Leveling	R Agor	Khanna Publications Limited edition ISBN-10 : 8174092358 ISBN-13 : 978-8174092359
5	प्रारंभिक सर्वेक्षण –I	Gurucharan Singh	Standard publishers distributors Delhi Published year 2017 ISBN: 9788180141751

(b) Online Educational Resources:

1. <https://onlinecourses.nptel.ac.in>
2. <https://archive.nptel.ac.in/courses/>
3. https://youtu.be/chhuq_t40rY
4. <https://yputube/Z4yHHX8NO>

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

(b) Others: many other valid sources.

- A) **Course Code** : 2411202(T2411202/P2411202/S2411202)
- B) **Course Title** : Agronomy and Horticulture and Plant protection
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

The agriculture engineer must have the in-depth understanding about the agronomical, horticultural and plant protection practices of various crops. It is well recognized that agricultural industries are running based on both agronomical & horticultural crops, which shares a good part in the economy provided by agriculture. The in depth understanding and skills required in the pass-outs of Agri. Engineering Diploma Programme. This course is design to provide exposure to the students on both systems and operations of agronomy & horticulture

- 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.** Develop weather based agro-advisories to sustain crop production utilizing various agricultural components.
- CO-2.** Analyze both weed problems and seed technology.
- CO-3.** Develop innovative agro-techniques to enhance the production and productivity of agricultural crops.
- CO-4.** Evolve strategies to Increase farmers income through adopting hi-tech horticulture & create job opportunities for unemployment.
- CO-5.** Apply effective measures for protection of plants from pest & disease.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes*(PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO-1	3	-	-	-	-	-	1	-	-
CO-2	3	2	1	1	1	-	1	-	-
CO-3	3	2	1	1	1	-	1	-	-
CO-4	3	-	-	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				
2411202	Agronomy and Horticulture and Plant protection	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)	
2411202	Agronomy and Horticulture and Plant protection	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: T2411202**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.1a</i> Apply the techniques to cultivate the cereals like wheat, maize, rice and other oilseeds as well as pulses.</p> <p><i>TSO.1b</i> Classify the crop according to environment like tropical, sub-tropical & temperature.</p> <p><i>TSO.1c</i> Select the crop variety according to rainfall in the area</p> <p><i>TSO.1d</i> Use crop rotation methods in Dryland</p> <p><i>TSO.1e</i> Use different rainfall instruments & weather data recording instruments for different weather conditions and time.</p> <p><i>TSO.1f</i> Apply techniques of land preparation seed rate, spacing, fertilizer dose, insect's management practices, Pests & diseases control.</p> <p><i>TSO.1g</i> Assess the day's to maturity and accordingly decide harvesting techniques of various cereals like paddy, wheat, maize, Bangal gram, pea, Black gram, Pigeon pea etc.</p>	<p>Unit-1.0 Agronomy & Crop Rotation</p> <p>1.1 Importance and scope of agronomy.</p> <p>1.2 Classification of crops according to place of origin, Botanical, Commercial, Economics, Seasonal, Ontogenic, Agronomics.</p> <p>1.3 Basic of agro-metrology climate and weather, factors affecting climate and weather.</p> <p>1.4 Effect of light intensity, quality, direction & duration on crop production.</p> <p>1.5 Raising techniques of various cereals crops like (Rice, Wheat, Barley, Maize).</p> <p>1.6 Raising techniques of various Pulses crops like (Lentils, Black Gram, Pigeon pea, Arhar)</p> <p>1.7 Dry land agriculture, Dry farming, Dry land farming, Rainfed farming, problem & prospects of dry land farming.</p>	CO 1
<p><i>TSO.2a</i> Interpret the factors of germination such as humidity, temperature etc.</p> <p><i>TSO.2b</i> Identify the types of breeder seed, foundation seed, registered seed and certified seed.</p> <p><i>TSO.2c</i> Explain the characteristics of weed and its harmful effects.</p> <p><i>TSO.2d</i> Classify weeds and their medium of dispersal.</p> <p><i>TSO.2e</i> Describe weed control methods like mechanical, biological and chemical.</p>	<p>Unit-2.0 Seed Technology and Weed Problems</p> <p>2.1 Factors affecting germination and growth, Seed index, Purity percentage.</p> <p>2.2 Type of pure seed Nucleus seeds, foundation seeds, Registered seed, Certified seed, Improved seed.</p> <p>2.3 Meaning criteria of weed, Classification of weed, Characteristics of weed, multiplication and dissemination.</p> <p>2.4 Weed control, Preventive method, Curative method, Biological method & Chemical method classification.</p>	CO 2
<p><i>TSO.3a</i> Ensure the suitability of soil for horticultural crops.</p> <p><i>TSO.3b</i> Describe the importance of nursery raising.</p> <p><i>TSO.3c</i> Analyze the importance of vegetables in human nutrition.</p> <p><i>TSO.3d</i> Propagate the nursery plant of fruit, vegetable, flowering plant, by seed, cutting, tissue culture.</p> <p><i>TSO.3e</i> Explain the roles of fruit crops and their importance in industry of India.</p>	<p>Unit-3.0 Horticultural Crops & Nursery Management</p> <p>3.1 Importance & classification of crops. Olericulture, Pomology, Floriculture, Fruit & vegetable.</p> <p>3.2 Raising techniques of various horticulture crops like Mango, Guava, Banana, Papaya, Potato Onion, Okra, Brinjal, Rose, Jasmine.</p> <p>3.3 Different method of plant propagation & nursery management techniques.</p>	CO 3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.4a</i> Explain the method to propagate a crop under control environment and aesthetic conditions.</p> <p><i>TSO.4b</i> Describe about the benefit of tissue culture.</p> <p><i>TSO.4c</i> Illustrate the process of rapid multiplication of desirable genotype.</p> <p><i>TSO.4d</i> Prepare disease free plant in nursery using hi-tech horticulture.</p>	<p>Unit-4.0 Hi-Tech Horticulture</p> <p>4.1 Introduction, importance & scope of hi-tech horticulture in India.</p> <p>4.2 Hi-tech nursery management & mechanization of horticulture.</p> <p>4.3 Importance of tissue culture, INM& IPM.</p> <p>4.4 Micro propagation of horticultural crops.</p> <p>4.5 Hi-tech field preparation & planting method.</p>	CO 4
<p><i>TSO.5a</i> Explain applications of different plant protection equipment like Sprayer & duster.</p> <p><i>TSO.5b</i> Identify the fungal bacterial viral disease of different major crops.</p> <p><i>TSO.5c</i> Assess the causes of damage of different major crops due to insect, pest</p> <p><i>TSO.5d</i> Describe the approach of Integrated Pest Management.</p> <p><i>TSO.5e</i> Use insecticide and pesticides to eradicate the insect and paste.</p> <p><i>TSO.5f</i> Select insecticide and pesticides as per requirement</p>	<p>Unit-5.0 Plant Propagation and Disease Control of Various Crops</p> <p>5.1 Plant protection- Its importance and various methods like Physical, chemical & biological methods.</p> <p>5.2 Plant protection equipment- Sprayer, duster & some advance techniques like drone technology, eco-friendly Insecticides & pesticides.</p> <p>5.3 Plant pathology- Study about plant diseases like bacterial disease, mycoplasma/Phytoplasma disease, Viral diseases & crop diseases and its prevention.</p> <p>5.4 Entomology- Various insect found in different crop and its prevention through Insecticides & pesticides.</p>	CO 5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2411202

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Classify crops and seeds according to the different seasons	1.	Identify kharif crops, Rabi crop & seeds from the given crops sample	CO 1
LSO 1.2 Identify the various Horticulture crops	2.	Identify important fruits, flower & vegetable crops	CO 1
LSO 1.3 Manage systematic bed preparation for nursery	3.	Prepare nursery bed/seed bed	CO 1
LSO 1.4 Perform various techniques of pruning for optimum growth and yield.	4.	Perform pruning and training of some important fruit crop	CO 1
LSO 1.5 Develop nursery bed	5.	Develop proper area for performing nursery bed having well dispersal fertile loamy soil rich in organic matter	CO 1, CO 3
LSO 2.1 Select types of seed treatments of various crops as per the requirement.	6.	Perform seed treatment of given crops sample	CO 2
LSO 2.2 Protect plant from weeds	7.	Identify different types of weeds	CO2
LSO 2.3 Use seed drill.	8.	Calibrate seed drill	CO 2
	9.	Operate seed drill	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 2.4 Calculate seeds of various horticultural crops according to the size of farms.	10.	Determine requirement of seed and plant population for the given situation	CO2
LSO 2.5 Use pest and identify disease of various plant such as Mango, Guava, flowers	11.	Identify important pest and disease in the given sample	CO 2
LSO 2.6 Identify nursery diseases and manage it.	12.	Identify viral and bacterial diseases in plant in a given sample	CO2
LSO 2.7 Use seed sowing method	13.	Use different methods to sow seed in nursery	CO2
LSO 3.1 Determine nursery area	14.	Measure nursery area and seedlings quantity	CO3
LSO 3.2 Plant propagation by different cutting method	15.	Prepare hardwood cutting for the given plant.	CO3
LSO 3.3 Plant propagation by layering	16.	Prepare simple layering.	CO3
LSO 3.4 Perform different types of grafting	17.	Perform veneer grafting on the given plant	CO3
	18.	Perform cleft grafting	CO3
LSO 3.5 Perform different types of budding	19.	Perform T– budding	CO3
LSO 4.1 Stump preparation and planting	20.	Prepare stump and do planting.	CO4
LSO 4.2 Perform hi-tech horticulture practices.	21.	Perform Hi-tech horticulture experimentation under protected cultivation.	CO4
LSO 4.3 Prepare Hi-tech nursery	22.	Develop Hi-tech field for given nursery preparation.	CO4
LSO 5.1 Plan for plant protection	23.	Use sprayer, duster and drone for plant protection.	CO5

L) **Suggested Term Work and Self Learning: S2411202** 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. Describe the procedure/ steps for developing a area for nursery bed.
- ii. Interpret the factors of germination

b. **Micro Projects:**

- i. Design Vegetable seed extractor
- ii. Prepare a report on agricultural climate in relation to crop planning and assessment of crop production potentials in a given area.
- iii. Prepare a report on influence of weather on the incidence of pests & diseases of field crops.
- iv. Provide weather based agro advisories using medium range weather forecasts & ICT.

c. Other Activities:

1. Seminar Topics:

- Tissue culture
- Advance seed technology
- Effect of different factors on crop production

2. Visits:

- Visit nearby min 03 nursery and prepare a report on the technologies used for plantation and management of nursery
- Visit near by Hi tech nursery and prepare the report on machine and equipment's used with their specifications

3. Self- learning topics:

- Advancement in agronomy and horticulture
- Latest research and development done in the area of agronomy and horticulture

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 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 Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Agronomy and Crop Rotation	8	CO1	7	3	2	2
Unit-2.0 Seed Technology and Weed Problems	8	CO2	14	5	4	5
Unit-3.0 Horticultural Crops & Nursery Management	10	CO3	14	5	5	4
Unit-4.0 Hi-Tech Horticulture	12	CO4	14	3	4	7
Unit-5.0 Plant Propagation & Disease Control of Various Crops	10	CO5	21	4	8	9
Total Marks	48	-	70	20	23	27

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.	Identify kharif crops, Rabi crop & seeds from the given crops sample	CO 1	50	40	10
2.	Identify important fruits, flower & vegetable crops	CO 1	50	40	10
3.	Prepare nursery bed/seed bed	CO 1	50	40	10
4.	Perform pruning and training of some important fruit crop	CO 1	50	40	10
5.	Develop proper area for performing nursery bed having well dispersal fertile loamy soil rich in organic matter	CO 1, CO 3	50	40	10
6.	Perform seed treatment of given crops sample	CO 2	50	40	10
7.	Identify different types of weeds	CO2	50	40	10
8.	Calibrate seed drill	CO 2	50	40	10
9.	Operate seed drill	CO2	50	40	10
10.	Determine requirement of seed and plant population for the given situation	CO2	50	40	10
11.	Identify important pest and disease in the given sample	CO 2	50	40	10
12.	Identify viral and bacterial diseases in plant in a given sample	CO2	50	40	10
13.	Use different methods to sow seed in nursery	CO2	50	40	10

S. No	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva- Voce (%)
			PRA * (%)	PDA ** (%)	
14.	Measure nursery area and seedlings quantity	CO3	50	40	10
15.	Prepare hardwood cutting for the given plant.	CO3	50	40	10
16.	Prepare simple layering.	CO3	50	40	10
17.	Perform veneer grafting on the given plant	CO3	50	40	10
18.	Perform cleft grafting	CO3	50	40	10
19.	Develop proper area for performing nursery bed having well dispersal fertile loamy soil rich in organic matter	CO 1, CO 3	50	40	10
20.	Prepare stump and do planting.	CO4	50	40	10
21.	Perform Hi-tech horticulture experimentation under protected cultivation.	CO 4	50	40	10
22.	Develop Hi-tech field for given nursery preparation.	CO4	50	40	10
23.	Use sprayer, duster and drone for plant protection.	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.	Plough	Indigenous plough, m.b. plough, disc plough	all
2.	Cultivator	Disc cultivator, rotary cultivator & tyne cultivator	all
3.	Harrow	Disc harrow, spring tooth harrow, tandem harrow, offset harrow, guntka harrow	all
4.	Seeding equipment	Dibbler, seed drill & seed cum fertilizer drill	8,9
5.	Planter	Sugar cane planter, potato planter	2, 4,20
6.	Sprayer & duster	Power sprayer, hydraulic sprayer & hand sprayer, Plunger type, knapsack, rotary & power operated sprayer, weeder	23

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
7.	Propagation	Budding knife, cutting knife	17, 18
8.	Cutting	Secateurs, loppers	15,16
9.	Hi-tech cultivation	Laminar flow, UV-light tube	21
10.	Agriculture Pesticide Spraying Drone	<p>Agriculture UAV designed with fireproof, rainproof and dustproof</p> <ul style="list-style-type: none"> • Extremely light weight, maximum capacity of up to 5.3- 5.5 kg • Convenient replacement and maintenance • High stability power device, dynamic power redundancy • GPS hover, pointing flight and automatic route flight function 	23

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principle of Agronomy	S.R.Reddy	Kalyani publisher, 6 th ed.,2023 ASIN: B0BY52CNX4
2.	Modern Techniques of Raising Field Crops	ChiddaSingh, Prem Singh, Rajbir Singh	CBS publishers & distributors pvt ltd, 4 th ed, 2021 ISBN-13: 978-9354660696
3.	Ecological Management of Agricultural Weeds	Charles L. Mohler, Staver, Charles P., Matt Liebman	Cambridge University Press; 1st edition 2007 ISBN-13 : 978-0521037877
4.	Basics concept of fruit sciences	Neeraj Pratap Singh	CBS Publishers; 2 nd ed, 2015 ASIN: B0CCJINYQZ
5.	Weed Management: Principles and Practices	O.P. Gupta	Agrobios (India) 3rd edn, 2011 ISBN-13 : 978-8177544237
6.	Economics of Farm Production and Management	V. T. Raju	Oxford & IBH Publishing Co Pvt.Ltd, 2017 ISBN-13 : 978-8120404236
7.	Instant Horticulture	S.N. Gupta	Jain Brothers,2023, 21 st ed, 2023 ASIN B0BW4X1N71 :
8.	Handbook of Horticulture in 02 Vols	Kusum Lata Chadha	DSR Book Distributors, 2019 ISBN-13 : 978-8171641871
9.	Basic Horticulture	Jitendra Singh	KALYANI PUBLISHERS, 2021 ASIN B0B77NQDFM :
10.	Introduction to Horticulture	N. Kumar	Medtech Science Press, 9th edition,2021 ISBN-13 : 978-8195237296
11.	Textbook on Horticulture	Rajneesh Singh, Bijendra Kumar Singh	New India Publishing Agency- NIPA, 2020 ISBN-13 978-9389571776 :

(b) Online Educational Resources:

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

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:

1. Visit to KVK
2. Lab Manuals

- A) **Course Code** : 2420103(T2420103/P2420103/S2420103)
 B) **Course Title** : Fundamentals of Electrical and Electronic Engg.
 (CSE, AIML, ME, ME (Auto), MIE, AE, CRE, CHE, TE)
 C) **Pre- requisite Course(s)** : Engineering Physics, Basic Algebra and Calculus
 D) **Rationale** :

This course is a fundamental course included in the curriculum mainly to introduce the students of Computer Science and Engineering, Artificial Intelligence and Machine Learning diploma courses to the basic concepts and basic laws of electricity, principle of magnetism and electromagnetic induction, basic electrical and electronics components and also to the basics of digital electronics so that students will be able to apply the same for solving the day to day basic electrical engineering problems in their own discipline. Diploma holders are expected to apply the fundamentals of this course while working with equipment being operated with electrical sources and while using various types of electrical equipment and instruments in their 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. Apply basic concepts of electricity to determine various electric parameters in a given electrical system.
 CO-2. Apply the fundamental laws and concepts of DC and AC circuits to a given electrical system.
 CO-3. Apply the principles of magnetism and electromagnetism to a given equipment.
 CO-4. Test the functionality of a given basic electronic component.
 CO-5. Use Boolean expressions and number systems to realize the basic logic circuits.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs) (if any)	
	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	2	2	-	2		
CO-2.	3	3	3	2	1	1	2		
CO-3.	3	3	3	2	2	-	2		
CO-4.	3	2	2	2	2	1	2		
CO-5.	3	2	2	2	2	1	2		

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Studies (Hours/Week)					
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (SW+ SL)	Total Hours (CI+LI+SW+SL)	Total Credits(C)
		L	T				
2420103	Fundamentals of Electrical and Electronic Engineering	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 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, open educational resources (OERs)

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)	
2420103	Fundamentals of Electrical and Electronic Engg.	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: T2420103**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.1a Apply the concept of charge, voltage and current in the given electrical circuit TSO.1b Differentiate between AC and DC currents. TSO.1c Differentiate between practical and Ideal current/voltage source TSO.1d Calculate work, power, and energy in the given circuit TSO.1e Calculate the equivalent resistance/Capacitance/ inductance in the given series and parallel electric circuit. TSO.1f Explain the heating/magnetic/chemical effect of the electric current with a relevant application. TSO.1g Calculate the energy stored in a given resistor/capacitor/inductor. TSO.1h Explain the effect of various media on capacitance TSO.1i Explain behavior of current in a resistor/capacitor/inductor.	Unit-1.0 Basic Electrical Parameters and Concepts 1.1 Electric charge, flow of charges, Electric Current D.C and A.C, Concept of ideal and practical current sources 1.2 Analogy of charge, potential /Voltage difference D.C and A.C, Induced emf/voltage, Terminal voltage, Concept of Ideal & Practical voltage sources 1.3 Resistor - Properties, Classification, Practical application of resistors, Effect of temperature on resistance, Series and parallel combination of resistors, Phase difference 1.4 Heating, magnetic and chemical effect of current, Electrical work, Power and energy, Open and short circuit condition of electric circuit 1.5 Capacitors – Properties, Capacitance formation, Expression for capacitance, Capacitive reactance, Energy stored in capacitor, Series & parallel combination of capacitors, Types of capacitors including super capacitors and their applications 1.6 Inductors – Properties, Self and mutual inductance, inductive reactance, Voltage and current equations of inductor, Energy stored in inductor, Inductance in A.C. and D.C. circuits, Types of Inductors including MEMS inductor and their applications	CO-1
TSO.2a Differentiate between- <ul style="list-style-type: none"> ● AC and DC current in all aspects (Generation, Waveforms and applications) ● Active and passive elements ● Linear & Non-linear circuit ● Unilateral and Bilateral circuit ● Loop and mesh in a given circuit TSO.2b Apply Ohm's law and Kirchoff's laws to determine current and voltage in a given circuit. TSO.2c Explain various AC fundamental parameters. TSO.2d Use operator 'j' to calculate various quantities in A.C circuit	Unit-2.0 Fundamentals of D.C. and A.C. Circuits DC Circuits 2.1 AC and DC current, voltage and Power 2.2 Ohm's law, Kirchoff's Current Law, Kirchoff's Voltage law 2.3 Active & Passive elements, Linear & Non-linear circuit, unilateral and Bilateral circuit element, 2.4 Node, Branch, Loop, Mesh A.C Circuits 2.5 Frequency, Time period, Amplitude, Angular Velocity, RMS Value, Average Value, Form factor, Peak factor, Power factor 2.6 Phasor representation and transformation from Polar to rectangular form and vice versa of alternating quantities	CO1, CO2
TSO.3a Explain various terms related to magnetic circuit.	Unit-3.0 Magnetic Circuits and Electromagnetic Induction	CO2, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO.3b Calculate various parameters of a given magnetic circuit.</p> <p>TSO.3c Plot B-H curve and Hysteresis loop of a given magnetic materials</p> <p>TSO.3d Explain the phenomenon of induced e.m.f and current</p> <p>TSO.3e Apply principles of Faraday's law to calculate induced e.m.f in the given circuit</p> <p>TSO.3f Apply various Laws in a given magnetic circuits</p>	<p>3.1 Magnetic flux, Magnetomotive force, Magnetic field strength, Permeability, Reluctance.</p> <p>3.2 Magnetic leakage, leakage coefficient</p> <p>3.3 Magnetic Hysteresis, Hysteresis loop,</p> <p>3.4 Magnetization (B-H) Curve</p> <p>3.5 Analogy between electric and magnetic circuits</p> <p>3.6 Electromagnetism</p> <p>3.7 Induced e.m.f -Statically (self and mutual) and dynamically induced emf,</p> <p>3.8 Faraday's Laws of electromagnetic Induction.</p> <p>3.9 Lenz's Law, Fleming's R.H. rule; direction of induced E.M.F, Fleming's L.H. rule, Ampere's Law</p>	
<p>TSO.4.a Describe the construction and working principle of the given type of semiconductor</p> <p>TSO.4.b Describe the principle of the given type of semiconductor.</p> <p>TSO.4.c Describe between the given type insulator, conductor and semiconductor based on energy band theory.</p> <p>TSO.4.d Describe working principle, characteristics and application of the given type of diode.</p> <p>TSO.4.e Describe working principle of the given type of Bipolar Junction Transistor.</p> <p>TSO.4.f Describe working principle of the given type of Field Effect Transistor.</p>	<p>Unit-4.0 Basic Electronic Components</p> <p>4.1 Semiconductors: Definition, types of semiconductors and their materials. Energy band theory and effect of temperature.</p> <p>4.2 Diodes: Basic Concept of Diodes, N-type & p-type PN Junction Diode – Forward and Reverse Bias Characteristics i.e., PN junction Barrier voltage, depletion region, Junction Capacitance. Forward biased & reversed biased junction, Diode symbol</p> <p>4.3 Bipolar Junction Transistor (BJT): NPN and PNP Transistor – Operation and characteristics. symbol</p> <p>4.4 Field Effect Transistor (FET): FET – Operation and characteristics, Classification FET and advantages, FET symbol</p>	CO4
<p>TSO.5a Convert one number system to other number system.</p> <p>TSO.5b Use Boolean Algebra to solve expressions</p> <p>TSO.5c Implement Boolean expressions for given logic gates</p>	<p>Unit-5.0 Overview of Digital Electronics</p> <p>5.1 Introduction to different Number systems: Binary, Octal, Decimal & Hexadecimal & their Conversion from one another</p> <p>5.2 Introduction to Boolean Algebra, rules and Laws of Boolean Algebra – DE Morgan's Law</p> <p>5.3 Study of logic gates (NOT, OR, NOR, AND, NAND) Symbolic representation, Truth Table and Implementation of Boolean expressions</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2420103

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
<i>LSO 1.1.</i> Classify given electrical components in to Resistor, Inductor and Capacitor.	1.	Classification of electrical components	CO1
<i>LSO 1.2.</i> Plot the terminal voltage of a source starting from no load to different load (Current) conditions	2.	Terminal voltage of a source for different load conditions	CO1
<i>LSO 1.3.</i> Measure current and voltage in a branch of the given electric circuit	3.	Measurement of current and voltage in a branch of the electric circuit	CO1
<i>LSO 1.4.</i> Verify the zero Phase difference between current and voltage waveform for a resistor connected to an AC source with respect to time (using CRO).	4.	Phase difference between voltage and current waveform in a given resistor using CRO	CO1
<i>LSO 1.5.</i> Calculate the value of color-coded resistor and verify it by measuring the value of resistor using digital multimeter	5.	Value of color-coded resistor	CO1
<i>LSO 1.6.</i> Measure resistance in an series and parallel combination of resistors using digital multimeter	6.	Measurement of resistances in series and combination in an electric circuit.	CO1
<i>LSO 1.7.</i> Calculate the value of equivalent capacitance in series and parallel combination and verify by measuring the value of capacitance using digital multimeter	7.	Measurement of capacitance in series and parallel combination of Capacitors.	CO1
<i>LSO 2.1</i> Apply ohm's law to calculate voltage across each element in a given circuit	8.	Measurement of voltage across each element of the given linear circuit	CO1, CO2
<i>LSO 2.2</i> Determine currents using KCL in a given electric circuit and verify it by conducting experiment	9.	Measurement of current in the given electric circuit.	CO1, CO2
<i>LSO 2.3</i> Determine voltages using KVL in a given electric circuit and verify it by conducting experiment	10.	Measurement of voltage in a given electric circuit	CO1, CO2
<i>LSO 2.4</i> Verify the Phase difference (Lag) between current and voltage waveform for an inductor connected to an AC source with respect to time using CRO.	11.	Phase difference(lag) between voltage and current waveform in a given inductor	CO1, CO2
<i>LSO 2.5</i> Verify the Phase difference(lead) between current and voltage waveform for a capacitor connected to an AC source with respect to time using CRO.	12.	Phase difference(lead) between voltage and current waveform in a given capacitor using CRO	CO1, CO2
<i>LSO 2.6</i> Perform experiment to plot BH curve in a magnetic material	13.	BH curve of a given magnetic material	CO1, CO2
<i>LSO 3.1</i> Perform experiment to demonstrate statically and dynamically induced emf.	14.	Statically and Dynamically induced emf.	CO2, CO3
<i>LSO 3.2</i> Perform experiment to demonstrate self and mutual inductance.	15.	Self and Mutual inductance.	CO2, CO3
<i>LSO 3.3</i> Perform experiment to demonstrate Faraday's laws of electromagnetism	16.	Faraday's laws of electromagnetism.	CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO 3.4 Perform experiment to demonstrate Flemings right hand and left-hand rules	17.	Flemings right hand and left-hand rules.	CO2, CO3
LSO 3.5 Perform experiment to demonstrate Lenz's law	18.	Lenz's law.	CO2, CO3
LSO 4.1 Test the working of a given diode, and plot the labelled V-I characteristics	19.	VI characteristics of Diode.	CO4
LSO 4.2 Test the working of a given BJT and plot the labelled V-I characteristics.	20.	VI characteristics of BJT.	CO4
LSO 4.3 Test the working of a given FET and plot the labelled V-I characteristics	21.	VI characteristics of FET	CO4
LSO 5.1 Build and verify the truth tables for all logic gates – NOT, OR, NOR, AND, NAND	22.	Logic Gates – NOT, OR, NOR, AND, NAND	CO5

L) **Suggested Term Work and Self-Learning: S2420103** 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. Prepare a report on comparison of a physical system (containing two vertical water columns connected with a horizontal capillary tube and liquid flow due to gravity) to demonstrate the analogy of charge, potential difference and current flow in electrical system.
- ii. Prepare a report on types of resistors, their power ratings and relevant applications.
- iii. Calculate resistance value of a given resistor based on color codes and verify its value using multimeter.
- iv. Prepare a chart showing range of resistances used for electrical insulating materials.
- v. Sketch a plot of BH curve for soft and hard magnetic materials respectively.
- vi. Collect the information regarding various types of inductors used in different domestic appliances.
- vii. Prepare a chart of different types of capacitors used with their applications.
- viii. Prepare a chart illustrating an example to differentiate between useful and leakage flux.

b. **Micro Projects:**

1. Demonstrate the working of resistor, Inductor and Capacitor through role play or using animation
2. Prepare detailed specifications of a typical capacitor bank used for power factor improvement in an industry.
3. Prepare a chart for commonly used capacitors used in different domestic appliances (name of appliances with type and ratings)
4. Build and test the capacitor and choke in a fluorescent lamp for its proper working.
5. Connect three chokes in series and 40 Watt lamp in series with a switch across a single phase AC supply. Analyze the effect of switching action and comment on variation of voltage and current with respect to time.
6. Search animations demonstrating Faraday's laws of electromagnetic induction and Lenz's law to understand the concepts of electromagnetic induction and develop a presentation
7. Prepare a report on the comparison of technical parameters of NPN and PNP transistor.
8. Build and test the transistor switch circuit.
9. Build the logic gates and verify the truth table

c. Other Activities:

1. Seminar Topics;
 - Types of resistors, Inductors and capacitors and their application
 - Basic laws governing DC and AC circuits
 - Applications based on principle of electromagnetic induction.
2. Surveys;
 - Carry out a market survey for availability of different types of resistors used for small projects.
 - Survey a market for availability of different types of semiconductor diodes used for small projects.
3. Visit;
 - Visit institute laboratory/workshop and prepare report about the various electrical sources available along with their specifications.
 - Visit to a nearby electrical substation and observe the capacitors installed

d. Self-Learning Topics:

- Industrial/commercial applications of AC and DC supply
- Differentiate between AC and DC in terms of generation, waveforms, and power
- Conduct a literature survey and prepare list of materials (conducting, insulating, magnetic) and their corresponding applications commonly used in electrical system.
- Applications of statically and dynamically induced emf
- Different types of CROs available in the market
- Different types of Multimeter available in the market

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and sessional 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)**		Sessional Work Assessment (SWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Sessional Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	20%	20%	33%	20%	20%
CO-2	20%	25%	20%	20%	33%	25%	20%
CO-3	25%	25%	20%	20%	34%	20%	20%
CO-4	25%	20%	20%	20%	--	20%	20%
CO-5	15%	15%	20%	20%	--	15%	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 Basic Electrical parameters and concepts	8	CO1	11	4	4	3
Unit-.2.0 Fundamentals of DC and AC circuits	12	CO2	17	4	6	7
Unit-.3.0 Magnetic circuits and electromagnetic induction	10	CO3	17	4	6	7
Unit-.4.0 Basic electronic components	10	CO4	14	4	6	4
Unit-.5.0 Overview of Digital electronics	8	CO5	11	4	3	4
Total Marks	48	-	70	20	25	25

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.	Classification of electrical components	CO1	50	40	10
2.	Terminal voltage of a source for different load conditions	CO1	50	40	10
3.	Measurement of current and voltage in a branch of the electric circuit	CO1	50	40	10
4.	Phase difference between voltage and current waveform in a given resistor using CRO	CO1	45	45	10
5.	Value of color-coded resistor	CO1	50	40	10
6.	Measurement of resistances in series and combination in an electric circuit.	CO1	50	40	10
7.	Measurement of capacitance in series and parallel combination of Capacitors.	CO1	50	40	10
8.	Measurement of voltage across each element of the given linear circuit	CO1, CO2	50	40	10
9.	Measurement of current in the given electric circuit.	CO1, CO2	50	40	10
10.	Measurement of voltage in a given electric circuit.	CO1, CO2	50	40	10
11.	Phase difference(lag) between voltage and current waveform in a given inductor.	CO1, CO2	50	40	10
12.	Phase difference(lead) between voltage and current waveform in a given capacitor using CRO.	CO1, CO2	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA (%)	PDA (%)	
13.	BH curve of a given magnetic material.	CO1, CO2	50	40	10
14.	Statically and Dynamically induced emf.	CO2, CO3	50	40	10
15.	Self and Mutual inductance.	CO2, CO3	50	40	10
16.	Faraday's laws of electromagnetism.	CO2, CO3	50	40	10
17.	Flemings right hand and left-hand rules.	CO2, CO3	50	40	10
18.	Lenz's law.	CO2, CO3	60	30	10
19.	VI characteristics of Diode.	CO4	60	30	10
20.	VI characteristics of BJT.	CO4	60	30	10
21.	VI characteristics of FET.	CO4	60	30	10
22.	Logic Gates – NOT, OR, NOR, AND, NAND	CO4	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.	DC Source (Variable)	0-20/50 Volts	1-18
2.	AC Source (Variable)	0-300 Volts	1-18
3.	Voltmeter	0-300 V, 0-75 V (MI & MC)	1-18
4.	Ammeter	0-5/10/20 A (MI), 0-2 A (MC)	1-18
5.	Rheostats	0-50 Ohms, 5 Amp; 0-300 Ohms, 2 amp	
6.	Resistors, Capacitors, and Inductors	Appropriate ratings and different types	1, 6
7.	Demonstration kit for demonstrating statically and dynamically induced emf	Lab experiment purpose	14
8.	Demonstration kit to demonstrate self and mutual inductance.	Lab experiment purpose	15
9.	Demonstration kit for Faraday's laws of electromagnetic induction.	Lab experiment purpose	16
10.	Demonstration kit for Flemings right hand and left hand rules.	Lab experiment purpose	17
11.	Demonstration kit for Lenz's law.	Lab experiment purpose	18
12.	Multimeter	Digital Multimeter: 3 1/2-digit display, 9999 counts digital multimeter measures: V_{ac} , V_{dc} (1000V max), A_{dc} , A_{ac} (10 amp max), Resistance: (0 - 100 M Ω), Capacitance and Temperature measurement	5,7,19,20,21,22
13.	Electronic Work Bench	Bread Board 840 -1000 contact points: Positive and Negative power rails on opposite side of the board, 0-30 V, 2 Amp Variable DC power supply, Function Generator 0-2MHz, CRO: 0-30 MHz, Digital Multimeter	19,20,21,22
14.	CRO dual trace	25 MHz, 230 V AC, 50 Hz	4,12,19,20,21,22
15.	Electronic components Connecting probes	PN diode -NPN and PNP, BJT, FET, Logic gates OR, AND, NOT, NOR, NAND Connecting probes -1 set	19,20,21,22

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Basic Electrical Engineering	Mittle and Mittal	McGraw Education, New Delhi, 2015, ISBN: 978-0-07-0088572-5
2.	Fundamentals of Electrical Engineering	Saxena, S. B. Lai	Cambridge University Press, ISBN: 9781107464353
3.	Electrical Technology Vol- I	Theraja, B. L.	S. Chand Publications, New Delhi. 2015, ISBN: 9788121924405
4.	Basic Electrical and Electronics Engineering	Jegathesan, V.	Wiley India, New Delhi, 2015, ISBN: 97881236529513
5.	Principles of Electronics	Mehta, V.K.; Mehta, Rohit	S. Chand and Company, Ram Nagar, New Delhi-110 055, 504, 2014, ISBN: 9788121924
6.	Basic Electronic Engineering	Baru V.; Kaduskar R.; Gaikwad S.T.	Dream tech Press, New Delhi, 2015, ISBN: 9789350040126

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee64/preview
2. <https://archive.nptel.ac.in/courses/108/108/108108076/>
3. <https://nptel.ac.in/courses/122106025>
4. https://www.youtube.com/watch?v=Zr2SxTiKUCM&list=PLJvKqQx2Atc61XCOHXm_ACNkOkAm3yO4&index=4
5. <https://www.youtube.com/watch?v=9LNRAwf3uqs>
6. <https://de-iitr.vlabs.ac.in/List%20of%20experiments.html>

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

- A) **Course Code** : 2425104(T2425104/P2425104/S2425104)
- B) **Course Title** : Engineering Mechanics
(ELX, ELX (R), TE, CE, ME, EE, ME (Auto), MIE, FTS, AE, CRE, CHE)
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

In day-to-day working we come across different types of structures created for different purposes and functions, while designing the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements and to analyze different structural systems. The aim of this course is to help the student to comprehend the importance of applied mechanics and apply the principles of engineering mechanics to solve engineering problems.

- 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 Compute the force to solve the problems
- CO-2 Analyse various analytical and graphical conditions required for equilibrium of engineering systems.
- CO-3 Apply the principles of friction in various conditions to solve problems.
- CO-4 Calculate centroid, center of gravity and moment of Inertia of different geometrical shapes.
- CO-5 Select the relevant lifting machine(s) for the given 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	1	-	-		
CO-2	2	3	3	3	2	-	-		
CO-3	3	3	3	2	2	1	1		
CO-4	3	3	3	2	2	1	1		
CO-5	3	2	2	3	3	1	2		

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

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

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				
2425104	Engineering Mechanics	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)	
2425104	Engineering Mechanics	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: T2425104**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain concepts of the given terms.</p> <p><i>TSO 1b.</i> Use relevant units of various quantities in the given situations.</p> <p><i>TSO 1c.</i> Explain effects of a force on the given object.</p> <p><i>TSO 1d.</i> Resolve the given single force.</p> <p><i>TSO 1e.</i> Calculate the resultant of the given force system.</p> <p><i>TSO 1f.</i> Find the resultant of the given force system using law of parallelogram</p> <p><i>TSO 1g.</i> Determine graphically the resultant of the given force system by triangle law and polygon law.</p>	<p>Unit-1.0 Mechanics and Force System</p> <p>1.1 Significance and relevance: Mechanics, applied mechanics, statics and dynamics.</p> <p>1.2 Space, time, mass, particle, body, rigid body.</p> <p>1.3 Scalar and vector quantity, Units of measurement (SI units) Fundamental units and derived units.</p> <p>1.4 Force - unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force. Force system and its classification.</p> <p>1.5 Resolution of a force - Orthogonal and Non-Orthogonal components of a force, moment of a force, Avignon's Theorem.</p> <p>1.6 Composition of forces - Resultant, analytical method of determination of resultant for concurrent, non-concurrent and parallel co-planar force systems -Law of triangle, Law of parallelogram and law of polygon of forces.</p> <p>1.7 Graphic statics, graphical representation of force, Space diagram, force diagram, polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.</p>	CO1, CO2
<p><i>TSO 2a.</i> Draw the free body diagram for the given condition.</p> <p><i>TSO 2b.</i> Determine unknown force in the given situation using Lami's theorem.</p> <p><i>TSO 2c.</i> Identify the types of beams required for the given situation.</p> <p><i>TSO 2d.</i> Determine reactions in the given type of beam analytically.</p> <p><i>TSO 2e.</i> Solve problems using free body diagram and Lami's theorem.</p>	<p>Unit-2.0 Static Equilibrium</p> <p>2.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium.</p> <p>2.2 Equilibrium of force systems analytically</p> <p>2.3 Lami's Theorem.</p> <p>2.4 Types of beam (determinate and indeterminate), supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, distributed load, load, couple), span of beam.</p> <p>2.5 Beam reaction for cantilever, simply supported beam with or without overhang - subjected to combination of Point load and LTD load or Vertical Point load and couple.</p> <p>2.6 Beam reaction for simply supported beam subjected to vertical loads only.</p> <p>2.7</p>	CO1, CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO 3a. Calculate force of friction and coefficient of friction for the given condition or situation</p> <p>TSO 3b. Describe the conditions for friction for the given situation.</p> <p>TSO 3c. Identify the various forces acting on a ladder for the given conditions using free body diagram.</p> <p>TSO 3d. Compare the value of coefficient of friction between different surfaces.</p> <p>TSO 3e. Interpret the effect of change of masses, change of angle of inclination or both on the coefficient of friction</p> <p>TSO 3f. Calculate forces acting on a body that is moving on a horizontal rough surface</p> <p>TSO 3g. Determine the forces acting on a body that is moving on an inclined plane</p>	<p>Unit 3.0 Friction</p> <p>3.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.</p> <p>3.2 Equilibrium of bodies on level surface subjected to force parallel and</p> <p>3.3 inclined to plane.</p> <p>3.4 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. FBD of ladder in friction</p>	<p>CO3, CO4</p>
<p>TSO.4a Distinguish between centroid and center of gravity</p> <p>TSO.4b Calculate the centroid of geometrical plane figures.</p> <p>TSO.4c Calculate centroid of the given composite plane lamina</p> <p>TSO.4d Determine centre of gravity of the given simple solid.</p> <p>TSO.4e Determine centre of gravity of the given composite solid.</p> <p>TSO.4f Calculate Moment of Inertia of different geometric shapes.</p>	<p>Unit 4.0 Centroid, Centre of Gravity and Moment of Inertia</p> <p>4.1 Introduction to Centroid, Centre of Gravity and Areas</p> <p>4.2 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle).</p> <p>4.3 Centroid of composite figures composed of not more than three geometrical figures and centroid of perforated section, axis of symmetry</p> <p>4.4 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere).</p> <p>4.5 Centre of Gravity of composite solids composed of not more than two simple solids.</p> <p>4.6 Moment of inertia - Introduction, calculation of moment of inertia by integration method, theorem of perpendicular axis, theorem of parallel axis, moment of inertia of a rectangular section, hollow rectangular section, circular section, hollow circular section, triangular section</p>	<p>CO4</p>
<p>TSO.5a Describe the components of the given lifting machine.</p> <p>TSO.5b Differentiate the working principle of the given two types of lifting machines.</p> <p>TSO.5c Determine velocity ratio, efficiency of the given lifting machine.</p> <p>TSO.5d Calculate effort required and load lifted by the given lifting machine.</p> <p>TSO.5e Draw the graph with the given data</p> <p>TSO.5f Interpret the given graphs</p> <p>TSO.5g Select the relevant lifting machine for the given purpose with justification</p>	<p>Unit-5.0 Simple Lifting Machine</p> <p>5.1 Simple lifting machine, load, effort, mechanical advantage, Applications and advantages. Velocity ratio, efficiency of machines, Law of machine.</p> <p>5.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility</p> <p>5.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Screw jack, Weston's differential</p>	<p>CO2, CO5</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	pulley block, geared pulley block. 5.4 Graphs of Load versus Effort, Load versus ideal Effort, Load versus Effort lost in friction, Load versus MA, Load versus Efficiency.	

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2425104

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Use force polygon table to determine the resultant of concurrent forces	1.	Determine resultant of concurrent coplanar force system using force polygon table.	CO1, CO2
<i>LSO 2.1</i> Apply Lami's theorem <i>LSO 2.2</i> Use simply supported beams to find reactions	2.	Determine unknown force in a concurrent balance force system using Lami's Theorem.	CO1, CO2
	3	Find reactions at the supports of a simply supported beam and compare the results with analytical values.	
	4	Determine the support reactions for simply supported beam by <ul style="list-style-type: none"> • Beam reaction apparatus • Circular dial type weight 	
<i>LSO 3.1.</i> Apply law of friction on horizontal plane and inclined plane	5	Determine coefficient of friction on horizontal and inclined plane.	CO2, CO3
<i>LSO 3.2.</i> Coefficient of friction between different materials	6	Determine the coefficient of friction between two surfaces by <ul style="list-style-type: none"> • angle of repose methods • friction plane method 	
<i>LSO 3.3.</i> Coefficient of friction between belt and pulley.	7	Find the coefficient of friction between belt and pulley in a belt friction set up.	
<i>LSO 4.1.</i> Determine the centroid of different geometrical figures.	8	Determine the centroid of geometrical plane figures (squares, rectangle, triangle)	CO4
<i>LSO 4.2.</i> Find moment of inertia	9	Determine the moment of inertia of a fly wheel	
<i>LSO 5.1</i> Use simple screw jack <i>LSO 5.2</i> Use differential axle and wheel <i>LSO 5.3</i> Use single and double purchase crab winch	10	Find M.A, V.R and efficiency of screw jack.	CO5
<i>LSO 5.4</i> Use jib crane <i>LSO 5.5</i> Use worm and worm wheel apparatus	11	Find M.A, V.R and efficiency of differential wheel and axle	
	12	Calculate the efficiency of single purchase crab winch and double purchase crab winch	
	13	Determine forces in jib crane.	
	14	Determine the efficiency of worm and worm wheel.	

L) **Suggested Term Work and Self Learning: S2425104** 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:**

- i. Visit nearby tool room/industry and collect information regarding lifting machine used with their technical specification and their application and prepare comparison chart.
- ii. prepare model of simple lifting machine.
- iii. Prepare models of beam subject to point load, uniformly distributed loads, simply supported, overhang beam.
- iv. Prepare chart showing real-life examples including various types of forces.

c. **Other Activities:**

1. Seminar Topics:

- Collision of elastic bodies
- Law of **conservation of energy**
- concept of parallel axis and perpendicular axes theorem

2. Visits: Visit nearby tool room/industry with workshop facilities. Prepare report of visit with special comments of simple lifting machine to be used.

3. Self-Learning Topics:

- Types of load and beam.
- Various force system.
- Simple lifting machine.
- Centroid of various plane figure

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%	30%	15%	-	-	20%	20%
CO-2	10%	20%	10%	25%	-	10%	20%
CO-3	15%	20%	15%	25%	33%	15%	20%
CO-4	30%	10%	30%	25%	33%	15%	20%
CO-5	30%	20%	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 Mechanics and force system	14	CO1, CO2	16	5	3	8
Unit-2.0 Static Equilibrium	10	CO1, CO2	14	4	2	8
Unit-3.0 Friction	8	CO2, CO3	14	5	3	6
Unit-4.0 Centroid, Centre of gravity and Moment of Inertia	6	CO4	12	2	2	8
Unit-5.0 Simple lifting Machine	10	CO2, CO5	14	4	4	6
Total	48	-	70	20	14	36

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.	Determine resultant of concurrent coplanar force system using force polygon table.	CO1	45	45	10
2.	Determine unknown force in a concurrent balance force system using Lami's Theorem.	CO2	40	50	10
3.	Find reactions at the supports of a simply supported beam and compare the results with analytical values.	CO2	30	60	10
4.	Determine the support reactions for simply supported beam by <ul style="list-style-type: none"> • Beam reaction apparatus • Circular dial type weight 	CO1, CO2	30	60	10
5.	Determine coefficient of friction on horizontal and inclined plane.	CO2, CO3	40	50	10
6.	Determine the coefficient of friction between two surfaces by <ul style="list-style-type: none"> • Angle of repose method • Friction plane method 	CO2, CO3	40	50	10
7.	Find the coefficient of friction between belt and pulley in a belt friction set up.	CO2, CO3	30	60	10
8.	Determine the centroid of geometrical plane figures (squares, rectangle, triangle)	CO4	40	50	10
9.	Determine the moment of inertia of a fly wheel	CO4	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
10.	Find M.A, V.R and efficiency of screw jack.	CO2, CO5	30	60	10
11.	Find M.A, V.R and efficiency of differential wheel and axle	CO2, CO5	30	60	10
12.	Calculate the efficiency of single purchase crab winch and double purchase crab winch	CO2, CO5	30	60	10
13.	Determine forces in jib crane.	CO1, CO2	40	50	10
14.	Determine the efficiency of worm and worm wheel	CO2, 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, 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 and Tools	Broad Specifications	Relevant Experiment/Practical Number
1.	Differential axle and wheel	wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter	11
2.	Simple screw Jack	Table mounted metallic body, screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	10
3.	Worm and worm wheel	wall mounted unit with threaded spindle. load drum. effort wheel: with necessary slotted weights. hanger and thread.	14
4.	Single Purchase Crab winch	Table mounted heavy cast iron body. The wheel is of C.L material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	12
5.	Double Purchase Crab winch	Having assembly same as above but with double set of gearing arrangement.	11
6.	Weston's Differential pulley block	Consisting of two pulleys; one bigger and other smaller	13
7.	Weston's Differential worm geared pulley block	Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weight.	13
8.	Universal Force Table	Consists of a circular 40 cm dia. Aluminum disc. graduated into 360 degrees. with all accessories.	1, 2
9	Beam Reaction apparatus	The apparatus is with two circular dial type 10 kg.	3,4

S. No.	Name of Equipment and Tools	Broad Specifications	Relevant Experiment/Practical Number
10.	Friction apparatus for motion along horizontal and inclined plane	Base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees_ pan. Two weight boxes (each of 5 gm.10 cm, 2-20 gm. 2-50 gm, 2-100 gm, weight.	5,6
11	Set-up for belt friction apparatus	V and Flat Belt, Cap screw, Spring balance, Belt pulley, Torque cord, Load hanger x2, Weights	7
12	Fly wheel apparatus	flywheel, weight hanger with slotted weights, stop clock, metre scale etc	9
13	Jib crane	Jib Apparatus, Weight, Meter Rod, Set Square	13
14	Models of geometrical figures	Models of geometrical figures	8

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Applied Mechanics	R.S. Khurmi	S.Chand &Co. New Delhi 2014 ISBN: 9788121916431
2.	Engineering Mechanics	S. Ramamrutham	S Chand & Co. New Delhi 2008ISBN:9788187433514
3.	Foundations and Applications of Applied Mechanics	H.D. Ram A.K Chauhan	Cambridge University Press. Thomson Press India Ltd., NewDelhi, 2015, ISBN: 9781107499836
4.	Engineering Mechanics- Statics, Vol.1	J.L. Meriam L.G Kraige	Wiley Publication, New Delhi, ISBN: 978-81-265-4396
5.	Applied mechanics	R.K.Rajput	Laxmi publications (p) ltd. ISBN-13: 8105809631
6	Engineering Mechanics	A.R. Basu	TMH Publication, New Delhi
7	Engineering Mechanics	Timosheenko, Young & Rao	TATA McGraw-Hill Education, New Delhi

(b) Online Educational Resources:

1. <http://www.asnu.com.au>
2. www.youtube.com for videos regarding machines and applications, friction
3. www.nptel.ac.in
4. www.discoveryforengineers.com

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** : 2411205(T2411205/S2411205)
 B) **Course Title** : Greenhouse Technology
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Constructional and operational detail of greenhouse will lead the students to grow crops with profit and also to use the greenhouse for off season uses and also to manage them commercially. It helps the students to grow crops under control condition and to become entrepreneur. Students will learn construction of greenhouse with different materials and used to grow the crops under different season.

- 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 greenhouse for the given situation.
CO-2. Develop favorable micro climate which favors the crop production
CO-3. Design a layout for the greenhouse.
CO-4. Develop greenhouse as per the requirement
CO-5. Apply greenhouse irrigation techniques
CO-6. Maintain green house

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO-1	3	1	1	-	1	-	-		
CO-2	3	2	2	-	2	1	1		
CO-3	3	2	2	-	2	1	1		
CO-4	3	2	2	-	2	1	1		
CO-5	3	2	1	--	2	1	1		
CO-6	3	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				
2411205	Greenhouse Technology	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)	
2411205	Greenhouse Technology	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:

- 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: T2411205**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.1a</i> Explain greenhouse effect and its terminologies.</p> <p><i>TSO.1b</i> Classify different type greenhouse based on structure, based on utility, based on construction.</p> <p><i>TSO.1c</i> Compare different types of greenhouses to better match the plants to be grown inside the greenhouse to be built.</p> <p><i>TSO.1d</i> Explain the equipment and measuring devices (manual and automated) used inside a greenhouse to help grow plants more effectively.</p> <p><i>TSO.1e</i> Classify the greenhouse based on naturally ventilators poly house and environment and controlled polyhouse.</p> <p><i>TSO.1f</i> Compare the crop grown in open field and in greenhouse</p> <p><i>TSO.1g</i> Explain the benefits and limitations of carrying out crop cultivation in a greenhouse.</p> <p><i>TSO.1h</i> Describe the benefits and limitations of different types greenhouse.</p>	<p>Unit-1.0 Green House and its Classification</p> <p>1.1 Introduction to green house, historical background, status in India, greenhouse effect</p> <p>1.2 Classification of greenhouse –</p> <ul style="list-style-type: none"> • Based on Utility -Greenhouses for active heating, Greenhouses for active cooling. • Based on Construction -Wooden framed structure, Pipe framed structure, Truss framed structure. • Based on Covering Material- Glass greenhouses Plastic film greenhouses Rigid panel greenhouses • Based on Cost of Construction- High cost Green House, Medium cost Green House, Low cost Green House <p>1.3 Function of greenhouse.</p> <p>1.4 Types of greenhouse – Glass house, Net house, Poly tunnel</p> <p>1.5 Benefits and limitation of green house</p> <p>1.6 Manual and automated equipment's and measuring devices used in GH</p> <p>1.7 Natural and force ventilation summer and winter cooling system</p>	<p>CO1</p>
<p><i>TSO.2a</i> Apply the different environmental parameter to overcome the temperature and extreme cold.</p> <p><i>TSO.2b</i> Detect and control the temperature within an optimal growing range for plants being grown in a greenhouse.</p> <p><i>TSO.2c</i> Control water in a greenhouse, including irrigation and humidity.</p> <p><i>TSO.2d</i> Control nutrient levels in a greenhouse at optimal levels for plant growth and health.</p> <p><i>TSO.2e</i> Maintain light levels in a greenhouse for optimal plant production.</p> <p><i>TSO.2f</i> Manage the air characteristics inside a greenhouse.</p> <p><i>TSO.2g</i> Explain the process of automation for the greenhouse production.</p> <p><i>TSO.2h</i> Explain the effects of different parameters On growth of the plant in GH</p>	<p>Unit-2.0 Environmental Control in Greenhouses</p> <p>2.1 Plant response to greenhouse environment- light, temperature, relating humidity, ventilation and carbon dioxide.</p> <p>2.2 Temperature requirement of horticultural crops- Temperature Control in a Greenhouse, Heating Systems, Ventilation Systems</p> <p>2.3 Manual controlling thermostats microprocessors and computerized control system</p> <p>2.4 Water Management-Greenhouse Irrigation, Soil and Water, When to Irrigate, Plants and Water, Equipment and Methods Managing Light-Importance of Lighting in a Greenhouse, Artificial Lighting, Measuring Light, Controlling Light in the Greenhouse, Photoperiod Manipulation, Growth Rooms, Efficient</p>	<p>CO2</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.2i Apply different measure to reduce the effect of pollutant gases on plant TSO.2j Use automation in GH TSO.2k Select light as per the given situation TSO.2l Select nutrition for the plant as per the requirement TSO.2m Construct water management system for the given situation TSO.2n Analyze different environmental parameter to control the environment of greenhouse	Lighting Control Types of Greenhouse Lighting- Incandescent lights, Fluorescent grow lights, High Intensity Discharge (HID) lights, LED grow lights 2.5 Nutrition Management- Irrigation and Nutrition Control, Liquid Feed Systems 2.6 Managing Gasses-Carbon Dioxide Enrichment, Pollutant Gases, Temperature Control Systems (Ventilation) 2.7 Automation and Robotic Applications for Greenhouse Production, Automation in Vegetable Nurseries	
TSO.3.a Select site for the given situation TSO.3.b Select layout for the given situation TSO.3.c Design a layout as per the requirement. TSO.3.d Design heat distribution system as per the layout TSO.3.e Use solar air heater with latent storage energy to improve the greenhouse climate .	Unit-3.0 Location and Placing a Greenhouse 3.1 Site selection and layout – Recommendations for layout, criteria for site selection, selection of location, criteria for site layout, 3.2 Criteria for selecting greenhouse site- solar radiation, water, elevation, micro climate, level and stable ground, utilities, roads, availability of labor, management, residence. 3.3 Components of greenhouse like: roof, cable, cladding, gutter, purlin, ridge, girder. 3.4 Greenhouse heating and energy storage- type of head loss, heating system, heating distribution system. 3.5 Head house and storage facilities 3.6 Layout – Interior GH components and systems, types of Interior layout - Peninsula arrangement, cross bedding layout, Longitudinal layout Simple rules can help with proper siting of a greenhouse.	CO3
TSO.4a Explain the design criteria of green house TSO.4b Prepare design of GH as per the requirement TSO.4c Calculate different load conditions for designing a given GH. TSO.4d Select suitable raw materials to construct GH as per the requirement TSO.4e Describe local outdoor conditions for GH TSO.4f Select suitable cladding materials for the given situation TSO.4g Select suitable covering material and glazing material for the given situation TSO.4h Explain the size, spacing and height of greenhouse TSO.4i Compare the different kinds of covering materials TSO.4j Prepare cost estimate for green house construction.	Unit-4.0 Design and Construction of Greenhouse 4.1 Orientation- wind effects, size, spacing and height of GH, Design and construction of GH structure (IS 14462:1997) greenhouse. 4.2 Greenhouse Design a. local outdoor condition –Minimum, maximum and average temperature, Humidity, solar radiation, clearness of sky(clouds), precipitation (rain, hail and snow), average wind speed and wind direction b. based on cost of construction / technology-Low cost or low-tech GH, Medium cost or medium tech GH, High cost or hi-tech GH c. Based on suitability and cost, d. based on structure, e. based on utility,	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	<p>f. based on construction, g. based on covering material. h. Types of loads on structure- dead load, live load, wind load, snow load</p> <p>4.3 Green house construction</p> <p>a. Foundation – Temporary GH foundation, Tubing DR pipe foundation, concrete piper foundation, concrete masonry wall on poured concrete footing</p> <p>b. Floor, Frames</p> <p>c. Shape of the structure –</p> <ul style="list-style-type: none"> • Solarium or attached GH (connected to house)- Lean -to-GH, Even span type greenhouse, window- mounted GH • Free Standing GH (separate from other buildings consisting of sidewalls, end walls and a roof)- Quonset/hoop greenhouse, Modified Quonset/arch, Gable even span GH, Gable uneven span GH • Connected GH (several GH joined together)- Saw tooth type, Ridge and furrow type or gutter connected, Venlo-Dutch Houses, Barrel vault • Solar greenhouses <p>4.4 Cladding material - Glass GH, Plastic film GH, Rigid panel GH, cladding material property, UV stabilization, diffused film vs clear film, UV blocker, Infrared (IR) Additive, anti-dust, additive, Roof slope</p> <p>4.5 Greenhouse glazing materials- glass—single polycarbonate—double wall rigid plastic layer, polyethylene—single layer, factory-sealed double glass, polyethylene—double layer, polycarbonate film—triple or quad wall rigid, Plastic Infrastructure Elements: Temperature, Orientation, Ventilation & Light</p> <p>4.6 Greenhouse covers-NIR (Near Infrared) Filtering Materials, Clear Films and Diffusive Films, Photo-Selective Screens,</p> <p>4.7 Estimate Cost for greenhouse construction</p> <p>4.8 Applications: A model design for floricultural industry and Commercial Nursery Production</p>	
<p><i>TSO.5a</i> Select relevant irrigation systems as for the given green house.</p> <p><i>TSO.5b</i> Prepare soil mixes as per the requirement</p> <p><i>TSO.5c</i> Select containers as per the requirement</p> <p><i>TSO.5d</i> Differentiate between macro nutrient and micro nutrient</p> <p><i>TSO.5e</i> Differentiate different watering system</p> <p><i>TSO.5f</i> apply mulch as per the requirement</p>	<p>Unit-5.0 Greenhouse Irrigation and Maintenance of Green House</p> <p>5.1 Introduction to Irrigation systems and its classification</p> <p>5.2 Container - Cell Packs and Plug Trays, Wooden Flats Biodegradable Pots Soil Blocks</p> <p>5.3 Soil Mixes and Soil Mix Ingredients- Compost, Soil, Peat Moss, Coco Peat/Coir,</p>	<p>CO2</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO.5g</i> Prepare routine maintenance plan to maintain greenhouse</p> <p><i>TSO.5h</i> Apply various waste management practices.</p> <p><i>TSO.5i</i> Select recycling and disposing different types of waste as per the applicable regulations.</p> <p><i>TSO.5j</i> Describe the techniques to sterilize and sanitize the structure, components and equipment's using the approved disinfectants</p> <p><i>TSO.5k</i> Reduce the impact of pests and diseases on plants grown inside greenhouses.</p>	<p>Sand, Perlite, Vermiculite Lime or ground limestone, Nutrients, Fungal Inoculants</p> <p>5.4 Steps for Starting Seeds- Presoaking Seeds Planting Depth Seed Spacing</p> <p>5.5 Essential Elements for Seedling Growth- Macronutrients and Micronutrients</p> <p>5.6 Watering system -manual/ hand watering, Overhead irrigation system, Surface irrigation system, subsurface irrigation system, advantages and disadvantages</p> <p>5.7 Fertilization system, benefits and precautions.</p> <p>5.8 Mulching- plastic mulching advantages, type- black, white, red, yellow, mulching thickness, method of applying plastic mulch in vegetable and fruit crops.</p> <p>5.9 Routine maintenance activities of a greenhouse structure, water management and equipment's and machine</p> <p>5.10 Method of sanitization of parts and components of GH</p> <p>5.11 Recycling and disposing different types of waste</p>	

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: S2411205 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. Compare different covering material on the basis of sustainability.
- ii. Compare different construction methods of greenhouse on the basis of use, area, cost.
- iii. Calculate heat requirement of a framed greenhouse and heat requirement of Quonset type greenhouse.
- iv. Design a drip irrigation system for a given green house
- v. Estimate the cost of cultivation of specific crops for the given problem.
- vi. Prepare a report on different mulching practices used in horticultural crops.

b. Micro Projects:

- i. Prepare a working model of green house under the guidance of instructor.
- ii. Visit different greenhouses available nearby and prepare a report on the basis of utility, structure, area, automation used, layout and irrigation systems used.
- iii. Visit different greenhouses available nearby and prepare a report on types of maintenance activities followed, maintenance tools, methods of recycling waste, pesticides used.
- iv. Effects of different pesticides on the growth of the plants and on health of human beings

c. Other Activities:

1. Seminar Topics:
 - Advance technologies used in greenhouse development
 - Application of automation and robotics in different types of green house.
 - Storage of pesticides
 - Identification of different diseases in plant in GH.
2. Visits:
 - Visit different greenhouses located nearby and prepare a report
 - Visit different organization related with construction of green houses
3. Self-Learning Topics:
 - Smart Green House
 - Green house drying
 - Green house heating
 - Hydroponics
 - Plant nutrition

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%	-	-	-	-
CO-2	20%	20%	20%	25%	-	-	-
CO-3	20%	20%	20%	25%	33%	-	-
CO-4	25%	25%	20%	25%	33%	-	-
CO-5	20%	20%	25%	25%	34%	-	-
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.

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 Green house and its classification	10	CO1	13	4	4	5
Unit-2.0 Environmental Control in Greenhouses	12	CO2	14	4	4	6
Unit-3.0 Location and Placing a Greenhouse	10	CO3	14	4	5	5
Unit-4.0 Design and construction of greenhouse	12	CO4	15	4	5	6
Unit-5.0 Greenhouse irrigation and maintenance of Green house	10	CO5, CO6	14	4	4	6
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): (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.	Greenhouse technology	Gosh Arupratan	New India Publishing Agency, 2022 ISBN: 9789395319829
2.	Greenhouse technology for controlled environment	G. N. Tiwari	Narosa publisher, 2009 ISBN:13: 9781842651353
3.	Greenhouse technology and application	A K Sharma V M Salokhe	Agrotech Publications ISBN:9788183210577
4.	Greenhouse Horticulture: Technology for Optimal Crop Production	Cecilia Stanghellini Bert van 't Ooster Ep Heuvelink	Wageningen Academic Publishers, 2019 ISBN-13 : 978-9086863297

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
5.	Greenhouse Construction	S. C. Johnston	Legare Street Press, 2021 ISBN-13 978-101522809
6.	Greenhouse Technology: Principles and Practices	Arupratan Ghosh	CRC Press; 1st edition ,2019 ISBN-10 0367462389 : ISBN-13 978-0367462383 :
7.	Greenhouse Technology and Management 2012	Nicolas Castilla Esteban Baeza (Translator)	CABI Publishing; 2nd edition ,2012 ISBN-10 1780641036 : ISBN-13 978-1780641034 :

(b) Online Educational Resources:

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

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** : 2400108(T2400108)
 B) **Course Title** : **Essence of Indian Knowledge System and Tradition**
 (Common for all Programmes)
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

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

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

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

- CO-1** Identify the rich heritage and legacy residing in our Indian Knowledge systems.
CO-2 Correlate the technological & philosophical concepts of IKS with engineering domain specific problems and local problems for finding out possible solutions.

- F) **Suggested Course Articulation Matrix (CAM):**

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

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

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

G) Teaching & Learning Scheme:

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

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)	
2400108	Essence of Indian Knowledge System and Tradition	25	-	-	-	-	-	25

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: T2400108**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the architecture of the Ancient Indian Knowledge Systems.</p> <p><i>TSO 1b.</i> List the salient features of IKS.</p> <p><i>TSO 1c.</i> Comprehend the given IKS model.</p> <p><i>TSO 1d.</i> Identify the role and relevance of the given IKS model in contemporary society.</p>	<p>Unit-1.0 Introduction to Indian Knowledge Systems</p> <p>1.1 Overview of IKS</p> <p>1.2 Organization of IKS – चतुर्दश-विद्यास्थानं</p> <p>1.3 Conception and Constitution of Knowledge in Indian Tradition</p> <p>1.4 The Oral Tradition</p> <p>1.5 Models and Strategies of IKS</p>	CO1
<p><i>TSO 2a.</i> Enlist the importance of Veda, Vedanga, Visaya, Sikshaka.</p> <p><i>TSO 2b.</i> Describe the given IKS domain.</p> <p><i>TSO 2c.</i> Identify elements of mentioned IKS domains that are relevant to Technical Education System.</p> <p><i>TSO 2d.</i> Correlate the elements of mentioned IKS domains with given engineering domain.</p>	<p>Unit-2.0 Overview of IKS Domains and Relevance in Current Technical Education System.</p> <p>2.1 The Vedas as the basis of IKS</p> <p>2.2 Overview of all the six Vedāṅgas</p> <p>2.3 Relevance of following IKS domains in present Technical Education System:</p> <ul style="list-style-type: none"> • Arthashastra (Indian economics and political systems) • Ganita and Jyamiti (Indian Mathematics, Astronomy and Geometry) • Rasayana (Indian Chemical Sciences) • Ayurveda (Indian Biological Sciences / Diet & Nutrition) • Jyotish Vidya (Observational astronomy and calendar systems) • Prakriti Vidya (Indian system of Terrestrial/ Material Sciences/ Ecology and Atmospheric Sciences) • Vastu Vidya (Indian system of Aesthetics- Iconography and built-environment /Architecture) • Nyaya Shastra (Indian systems of Social Ethics, Logic and Law) • Shilpa and Natya Shastra (Indian Classical Arts: Performing and Fine Arts) • Sankhya and Yoga Darshna (Indian psychology, Yoga and consciousness studies) • Vrikshayurveda (Plant Science / Sustainable agriculture/food preservation methods) 	CO1, CO2

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

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

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

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

b. Micro Projects:

1. Write a report on any IKS domain highlighting the correlation with one domain specific engineering course.

c. Other Activities:

1. Seminar Topics: discuss any one IKS domain in details a highlighting the eminent works in the area.

2. Visits:

- Visit any nearby ancient temple and correlate the geometical, Shilpa and Vaastu on IKS dimensions specified in each domain.

3. Self-Learning Topics:

- Sustainable practices adopted in ancient India that can be applied for current engineering situations.

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	-	-	-	-	-	-	-
CO-2	100%	-	100%	100%	100%	-	-
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 AssessmentTable 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.	Introduction to Indian Knowledge System: Concepts and Applications	Archak, K.B. (2012).	Kaveri Books, New Delhi
2.	Introduction to Indian Knowledge System: Concepts and Applications	Mahadevan, B. Bhat, Vinayak Rajat Nagendra Pavana R.N.	PHI, ISBN: 9789391818203
3.	Glimpse into Kautilya's Arthashastra	Ramachandrudu P. (2010)	Sanskrit Academy, Hyderabad
4.	"Introduction" in Studies in Epics and Purāṇas, (Eds.)	KM Munshi and N Chandrashekara Aiyer	Bhartiya Vidya Bhavan

(b) Online Educational Resources:

1. <http://bhavana.org.in>
2. www.academia.edu/23254393/Science_in_Ancient_India_-_an_educational_module
3. www.academia.edu/23305766/Technology_in_Ancient_India_-_Michel_Danino
4. www.hamsi.org.nz/http://insaindia.res.in/journals/ijhs.php
5. www.niscair.res.in/sciencecommunication/ResearchJournals/rejour/ijtk/ijtk0.asp
6. www-history.mcs.st-andrews.ac.uk/Indexes/Indians.html

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. Swami Harshananda. "A bird's eye view of vedas". R K Math. Bangalore.,[http:// rkmathbangalore.org/Books/ABirdsEyeViewOfTheVedas.pdf](http://rkmathbangalore.org/Books/ABirdsEyeViewOfTheVedas.pdf).
2. Sanskrit Prosody, https://en.wikipedia.org/wiki/Sanskrit_prosody.
3. Vartak, P.V. (1995). "Veda and Jyotish," Part II, Chapter 2, in Issues in Veda and Astrology, H Pandya (Ed.), pp 65 – 73.
4. Sundaram, A.V. (1995). "Astrology: Its usefulness and Limitations in ModernTimes", Part II, Chapter 9, in Issues in Veda and Astrology, H Pandya (Ed.), pp 129 – 135.
5. Archak, K.B. (2012), "The Vedāṅga Literature", Chapter VIII in Essentials of Vedic Literature, Kaveri Books, New Delhi, pp 330 – 391.
6. Vasant Lad (1996), "Ayurveda: A Brief Introduction and Guide", (whole article).

- A) **Course Code** : 2400111(T2400111)
- B) **Course Title** : Principles of Management
(CE, AIML, AE, CHE, CSE, ME (Auto), FTS, MIE)
- C) **Pre- requisite Course(s)** :
- D) **Rationale** :

The course is designed to provide students with an overview of the management functions and its role in organizations and society. The course aims to provide students with the basic managerial knowledge necessary for engineering students in the world of work. The course focuses on providing students with analytical, developmental, managerial, and technical skills that relate to managerial positions in organizations. This course is an introduction to the critical management skills involved in planning, organizing, controlling, leading and decision making in an organization. It provides a framework for understanding issues involved in both managing and being managed, and it will help you to be a more effective contributor to organizations that you join.

- 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** Design strategic plan for various types of organizations.
- CO-2** Take decisions to handle world of work situations.
- CO-3** Formulate organizational hierarchy for different situations.
- CO-4** Identify various leadership styles.

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

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

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

G) Teaching & Learning Scheme:

Course Code	Course Title	Scheme of Study (Hours/Week)				
		Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
		L	T			
2400111	Principles of Management	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)	
2400111	Principles of Management	25	-	-	-	-	-	25

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.

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: T2400111

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the nature of management</p> <p><i>TSO 1b.</i> List the steps of evolution of management.</p> <p><i>TSO 1c.</i> Differentiate between different plans.</p> <p><i>TSO 1d.</i> Design Strategic plan for the given world of work situation.</p> <p><i>TSO 1e.</i> Take decisions in the given situation with justification.</p>	<p>Unit-1.0 Introduction to Management and Planning</p> <p>1.1 Nature and Purpose.</p> <p>1.2 Evolution of Management Thoughts.</p> <p>1.3 System approach to Management Process.</p> <p>1.4 Types of Plans: Missions or Purpose, Objective or Goals, Strategies, Policies, Procedures.</p> <p>1.5 Decision Making.</p>	CO1, CO2
<p><i>TSO 2a.</i> Differentiate formal and informal organizations.</p> <p><i>TSO 2b.</i> Identify the levels of hierarchy in the given organization.</p> <p><i>TSO 2c.</i> List the staffing principles.</p>	<p>Unit-2.0 Organizing and Staffing</p> <p>2.1 Nature of Organizing</p> <p>2.2 Formal and Informal Organization</p> <p>2.3 Principles of Organizing, Organizational Hierarchy, Authority, and Power.</p> <p>2.4 Staffing, Recruitment, Selection, Performance Appraisal.</p>	CO3
<p><i>TSO 3a.</i> Explain the theories of motivation</p> <p><i>TSO 3b.</i> Differentiate between leadership styles</p>	<p>Unit-3.0 Motivation and Leadership</p> <p>3.1 Motivation</p> <p>3.2 McGregor Theory of X and Y</p> <p>3.3 Maslow Hierarchy of Needs Theory</p> <p>3.4 Herzberg's Motivation- Hygiene Theory</p> <p>3.5 Leadership: Definition, Ingredients, Styles, theories</p>	CO4

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

J) 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.

- i. Describe about adopting the systems approach in any organization.
- ii. Write in brief about grapevine communication.
- iii. Compare the traits Theory of X and Y as proposed by McGregor

b. Micro Projects:

- Apply Maslow's need hierarchy theory in workplace.

c. Other Activities:

1. Seminar Topics:

- Importance of management theories in the corporates.
- The hierarchy levels create smoothness in functioning of any organization.
- Leadership practices that are popular in current scenario.

2. Visits:

- Visit nearby corporate setup and report
- Interview leaders in the organization and identify leadership style'

3. Self-Learning Topics:

- Herzberg's Motivation- Hygiene Theory
- Leadership theories
- Motivation for efficient productivity

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, 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.

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.	Fundamentals of Management: Essential Concepts and Applications	Robbins S.P. and DeCenzo David A	Pearson Education
2.	Koontz Essentials of Management	Koontz	Tata McGraw Hill Latest Edition
4.	Principles and Practices of Management	Shejwalkar and Ghanekar	Tata McGraw Hill Latest Edition
5.	Fundamentals of Management	Robbins and Dinzo	2002, Pearson India.
6.	Organization Theory, Structure, Design and Application	Stephen P. Robbins	PHI, New Delhi, 2005

(b) Online Educational Resources:

1. <https://www.coursera.org/learn/principles-of-management>
2. <https://alison.com/course/an-introduction-to-the-principles-of-management>
3. <https://www.udemy.com/course/principles-of-management-j/>
4. <https://lumenlearning.com/courses/principles-of-management/>
5. <https://www.mygreatlearning.com/academy/learn-for-free/courses/principles-of-management>
6. <https://onlineprogrammes.insead.edu/leadership-programme-for-senior-executives>
7. implilearn.com/general-management-certification-training-course?utm_source=google&utm_medium=cpc&utm_term
8. <https://discovery.ucl.ac.uk/id/eprint/10115948/1/Educational-Resource-Management.pdf>
9. <https://libraries.etsu.edu/research/guides/management/oer>
10. <https://www.cmu.edu/teaching/designteach/syllabus/checklist/learningresources.html>

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: -
