Curriculum

of

Diploma Programme

in

Electronics Engineering

State Board of Technical Education (SBTE)

Bihar

Semester – IV

Teaching & Learning Scheme

Board of Study	Course Codes	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2421401	**Linear Integrated Circuit** (ELX, ELX(R))	3	-	4	2	9	6
	2421402	**Microcontroller and its Applications** (ELX, ELX (R))	3	-	4	2	9	6
	2421403	**Digital Communication**	3	-	4	2	9	6
	2421404	**Electronic Equipment Maintenance**	-	-	4	2	6	3
	2418305	**Python Programming** (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	3	-	4	2	9	6
	2400207	**Indian Constitution** (Common for All Programmes)	1	-	-	-	1	1
	2400408	**Employability Skills Development** (Common for All Programmes)	1	-	-	-	1	1
	2400009	**Open Educational Resources** (Non-exam course) (FTS, CHE, CSE, EE, ME, ME (Auto), MIE, ELX, AIML, CRE, CACDDM, FPP, GT)	1	-	-	-	1	1
Total			**15**	**-**	**20**	**10**	**46**	**30**

Legend:

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

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

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

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

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

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

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

Semester - IV

Assessment Scheme

Board of Study	Course Codes	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)	
	2421401	**Linear Integrated Circuit** (ELX, ELX(R))	30	70	20	30	20	30	200
	2421402	**Microcontroller and its Applications** (ELX, ELX (R))	30	70	20	30	20	30	200
	2421403	**Digital Communication**	30	70	20	30	20	30	200
	2421404	**Electronic Equipment Maintenance**	-	-	20	30	20	30	100
	2421305	**Python Programming** (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	30	70	20	30	20	30	200
	2400207	**Indian Constitution** (Common for All Programmes)	25	-	25	-	-	-	50
	2400408	**Employability Skills Development** (Common for All Programmes)	25	-	-	-	-	-	25
	2400009	**Open Educational Resources** (Non-exam course)	25	-	-	-	-	-	25
Total			**195**	**280**	**125**	**150**	**100**	**150**	**1000**

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 : 2421401(T2421401/P2421401/S2421401)

B) Course Title : Linear Integrated Circuits (ELX, ELX (R))

C) Pre- requisite Course(s) : Basic Electronics, Analog Electronics

D) Rationale :

Linear Integrated Circuits, often referred to as analog integrated circuits, serve as fundamental building blocks in electronic systems. An op-amp is the most versatile Linear Integrated circuit used to develop various applications in electronics circuits and equipment. Hence this course is intended to develop the skill to build, test, diagnose, and rectify the Op-amp based electronic circuit and deals with various aspects of Linear Integrated Circuits used in various industrial, consumer, and domestic applications.

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

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

CO-1 Interpreted the step by step procedurals involved in IC fabrication.

CO-2 Use various configurations of Op-Amp for different applications.

CO-3 Troubleshoot various Op-Amp circuits for a given application.

CO-4 Use Op-Amp IC to design filters and oscillators**.**

CO-5 Use Multivibrator, PLL and VCO circuit for various applications.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Electronics Engineering	**2421401**	Analog Electronics	03	-	04	02	09	06

Legend:

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

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H) Assessment Scheme:

Board of Study	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)	
Electronics Engineering	**2421401**	Linear Integrated Circuits	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.

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I) Course Curriculum Detailing:

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: T2421401

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. List the advantages of ICs over discrete components. *TSO 1b.* Describe the processes involved in manufacturing of monolithic ICs. *TSO 1c.* Describe the process of construction of monolithic bipolar transistor. *TSO 1d.* Describe the process of construction of monolithic diode with the help of a transistor.	**Unit-1. IC Fabrication** 1.1 Advantages of ICs over discrete components 1.2 Classification of ICs on the basis of complexity: SSI, MSI, LSI, VLSI, ULSI 1.3 Fabrication process of monolithic ICs • Wafer Preparation • Epitaxial growth • Oxidation • Photolithography • Diffusion • Metallization • Circuit Probing • Scribing and separating into chips • Mounting and Packaging • Encapsulation 1.4 Step by step construction procedures of monolithic bipolar transistor, diode, capacitors and Integrated resistors 1.5 Sustainable process in IC fabrication	**CO-1**
TSO 2a. Select the Op-Amp based on Op-AMP parameters for the given application. *TSO 2b.* Describe with sketches the working of Op-Amp in various configurations. *TSO 2c.* Describe with sketches the working of Op-Amp in various modes. *TSO 2d.* Calculate the output voltage of the given inverting and Non-Inverting Op-amp. *TSO 2e.* Calculate the output voltage of Op-Amp circuit with the help of virtual ground concept.	**Unit 2 Fundamentals of Operational Amplifier** 2.1. Operational Amplifier: - Block diagram, Equivalent Circuit, Symbol, and basic terminology 2.2. Op-Amp IC 741 pin diagram and description 2.3. Op-Amp Configuration: Open Loop and Closed Loop, virtual ground concept 2.4. Op-Amp parameters: Input offset voltage, input offset current, input bias current, input resistance, Output Resistance, Open Loop voltage gain (Differential gain), Common mode gain, Common Mode Rejection Ratio (CMRR), Maximum output voltage Swing, Slew Rate 2.5. Parameters of Ideal and Practical Op-Amp 2.6. Modes of operations: Inverting and Non-Inverting	**CO-2**
TSO 3a. Calculate the output voltage of the given arithmetic circuit containing Op-Amp. *TSO 3b.* Explain with sketches the output of an Instrumentation amplifier. *TSO 3c.* Choose a relevant Op-Amp converter for the given application with justification. *TSO 3d.* Describe with sketches the working of Op-Amp as a comparator, peak detector, and zero crossing detector. *TSO 3e.* Describe the various applications of the Op-Amp circuit with the circuit diagram and I/O waveforms.	**Unit-3 Applications of Op-Amp** 3.1 Arithmetic Operations Circuit: Adder, Subtractor, Scaler, Integrator, Differentiator 3.2 Differential amplifier, Voltage Follower (Unity Gain Amplifier) 3.3 Op-amp as an Instrumentation amplifier: Working, Derivation of output voltage 3.4 Voltage to Current converter with floating and grounded load 3.5 Current to Voltage converter 3.6 Logarithmic Amplifier and Anti-Logarithmic Amplifier using diodes 3.7 Comparator 3.8 Zero Crossing Detector	**CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.9 Schmitt Trigger 3.10 Peak Detector 3.11 Sample and Hold Circuit	
TSO 4a. Describe the working of the given type of filter with sketches. *TSO 4b.* Explain with sketches procedure to identify the given type of filter based on frequency response. *TSO 4c.* Calculate the cutoff frequency of the given type of filter. *TSO 4d.* Describe with sketches the working principle of the given type of oscillator. *TSO 4e.* Calculate the frequency of oscillation of the given type of oscillator.	**Unit-4. Filters and Waveform Generators using Op-Amp** 4.1 Filter and its classification 4.2 Merits and demerits of active filters over passive filters 4.3 Responses of Ideal and Practical filters 4.4 Filters Characteristic terms: Order of filter, cutoff frequency, Passband, Stopband, Centre frequency, Bandwidth, Q factor 4.5 Filter types and their Frequency Response • Low Pass (First Order and Second Order) • High Pass (First Order and Second Order) • Band Pass (Wide and Narrow) • Band Reject (Wide and Narrow) • All Pass filter 4.6 Oscillators using IC 741 • R-C Phase Shift Oscillator • Wein Bridge Oscillator • Colpitts Oscillator • Hartley Oscillator	**CO-4**
TSO 5a. Describe with sketches the working of the analog multiplier. *TSO 5b.* Explain with sketches the working of IC-555 for the given application. *TSO 5c.* Calculate the duty cycle of the given type of multivibrator. *TSO 5d.* Describe with sketches the working of voltage controlled oscillator. *TSO 5e.* Explain with sketches the working of given blocks of PLL. *TSO 5f.* Explain the working of the given type of multivibrator and compare their speed of operations. *TSO 5g.* Explain with sketches the working of OTA for the given application.	**Unit-5 Special function ICs and their Applications** 5.1 Analog multiplier • Introduction • Pin diagram and pin function of analog multiplier IC AD633 5.2 IC-555 • Functional Block diagram • Pin diagram and functions of Timer 5.3 Multivibrators using IC-555 • Astable Multivibrator • Monostable Multivibrator • Bistable Multivibrator 5.4 Voltage Controlled Oscillator (VCO) • Introduction • Pin Diagram of NE/SE566 VCO • Basic block diagram • Operation of VCO 5.5 Phase Lock Loop (PLL) • Block diagram and its operation, Lock range and capture range • Pin diagram and Function of IC 565 • Applications of IC 565 PLL as a Frequency multiplier and FM Demodulator *5.7* Introduction to OTA (IC-CA3080A) and its Applications	**CO-5**

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2421401

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO 1.1. Measure input and output offset voltage. *LSO 1.2.* Calculate CMRR.	1.	Measure input offset voltage, output offset voltage, and common mode rejection ratio (CMRR) of op-amp IC-741.	CO2
LSO 2.1. Measure the peak-to-peak voltage of the output waveform on CRO.	2.	Measure the Output voltage swing parameter of op-amp IC-741	CO2
LSO 3.1. Measure the output voltage for various input voltages of inverting amplifier and non-inverting amplifier circuit. *LSO 3.2.* Determine the gain of the inverting amplifier and non-inverting amplifier.	3.	Measure the output voltage of Inverting and non Inverting OP-Amp for the given Input.	CO2
LSO 4.1. Construct the adder circuit using IC-741. *LSO 4.2.* Measure the output voltage of the adder circuit and compare it with theoretical calculation.	4.	1. a) Test IC-741 using IC tester,b)Build/Test adder and subtractor circuit consist of IC-741.	CO3
LSO 5.1. Measure the output voltage of integrator circuit for different input waveforms.	5.	Build/Test Integrator circuit consists of IC-741.	CO3
LSO 6.1. Measure the output voltage of differentiator circuits for different input waveforms.	6.	Build/Test Differentiator circuit consists of IC-741.	CO3
LSO 7.1. Test voltage to current converter circuit & and verify the measured value with calculated output. *LSO 7.2.* Test current to voltage converter circuit and verify the measured value with the calculate output.	7.	Build/Test Voltage to Current converter and Current to Voltage converter circuit consist of IC-741.	CO3
LSO 8.1. Interpreted and analyze the output of the Zero crossing detector and active positive peak detector.	8.	Build/Test comparator circuit consist of IC-741 as Zero crossing detector and active positive peak detector.	CO3
LSO 9.1. Interpreted and analyze the output of the Instrumentation amplifier circuit.	9.	Build/Test Instrumentation amplifier circuit using IC LM324.	CO3
LSO 10.1. Measure the bandwidth of first order low pass filter.	10.	Measuring of the bandwidth and cutoff frequency for a given first order low pass filter.	CO4
LSO 11.1 Interpreted and analyze the output of the second-order low pass filter.	11.	Build and test 2nd order active low pass filter using IC-741 Op-Amp.	CO4
LSO 12.1 Interpreted and analyze the output of first order high pass filter.	12.	Measuring of the bandwidth and cutoff frequency for a given first order high pass filter.	CO4
LSO 13.1 Interpreted and analyze the output of the second order high pass filter.	13.	Build and test a 2nd order active high pass filter using IC-741 Op-Amp.	CO4
LSO 14.1 Interpreted and analyze the output of the second order band pass filter.	14.	Build and test 2nd order active bandpass filter using IC-741 Op-Amp	CO4
LSO 15.1 Interpreted and analyze the output of second order band reject filter.	15.	Build and test a 2nd order active band reject filter using IC-741 Op-Amp.	CO4
LSO 16.1 Measure the frequency of oscillation of the RC Phase shift oscillator using IC 741.	16.	Measuring of the frequency of oscillation for given RC Phase shift oscillator circuit using IC-741.	CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant Cos Number(s)
LSO 17.1 Measure the frequency of oscillation of Wien Bridge oscillator.	17.	Build and test Wien bridge oscillator circuit using IC-741 and Measure output frequency.	CO5
LSO 18.1 Measure the frequency and duty cycle for a given waveform.	18.	Build/Test an astable multivibrator using IC-555 for the given specifications	CO5
LSO 19.1 Measure the frequency and duty cycle for a given waveform, monostable multivibrator circuit using IC-555.	19.	Build/Test monostable multivibrator using IC-555 for the given specifications.	CO5
LSO 20.1 Measure the frequency and duty cycle for a given waveform.	20.	Build/Test an astable multivibrator using IC-555 for the given specifications	CO5

L) Suggested Term Work and Self Learning: S2421401 Some sample suggested assignments, micro projects 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. Write applications of astable, bistable and monostable multivibrator.
ii. Describe the working of RC phase shift and Wein Bridge oscillator.
iii. Draw the frequency response waveform of first order LPF and HPF.

b. Micro Projects:

i. Develop a temperature control DC fan using IC 741
ii. Develop a tone generator using IC 555
iii. Develop a sound sensor using IC LM324 and a microphone.
iv. Build a frequency synthesizer using PLL IC 565.
v. Prepare a survey report on commercial ICs available in the local market with specifications and specific applications.

c. Other Activities:

1 Seminar:

i. Op-amp and its applications.
ii. Commercially available Op-amp ICs.
iii. VLSI technologies and their future aspects.
iv. Usage of ICs in consumer and industrial electronics appliances.

2 Industrial Visits:

i. Visit a nearby tool room/industry with IC fabrication facilities.
ii. Prepare a report on different IC fabrication techniques used in industries.

3 Self-learning topics:

i. Internet survey of Op-amp based linear circuit and their applications.
ii. Read the datasheet of various linear ICs.
iii. Test electronics equipment and components through a multimeter.

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	10%	15%	10%	25%	-	20%	25%
CO-3	15%	20%	15%	25%	33%	20%	25%
CO-4	30%	25%	30%	25%	33%	30%	25%
CO-5	30%	25%	30%	25%	34%	30%	25%
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 (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 IC Fabrication	8	CO1	10	4	4	2
Unit-2.0 Fundamentals of Operational Amplifier	8	CO2	12	4	4	4
Unit-3.0 Linear and non-linear applications of Op-Amp	10	CO1, CO2	14	4	4	6
Unit-4.0. Filters and Waveform Generators using Op-Amp	10	CO3, CO4	18	4	8	6
Unit-5.0 Special function ICs and their applications	12	CO4, CO5	16	4	6	6
Total Marks	**48**	**-**	**70**	**20**	**26**	**24**

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 input offset voltage, output offset voltage, and common mode rejection ratio (CMRR) of op-amp IC-741.	CO2	60	40	10
2.	Measure the Output voltage swing parameter of op-amp IC-741	CO2	60	40	10
3.	Measure the output voltage of Inverting and non Inverting OP-Amp for the given Input.	CO2	60	40	10
4.	1. a)Test IC-741 using IC tester,b)Build/Test adder and subtractor circuit consist of IC-741.	CO3	60	40	10
5.	Build/Test Integrator circuit consists of IC-741.	CO3	60	40	10
6.	Build/Test Differentiator circuit consists of IC-741.	CO3	60	40	10
7.	Build/Test Voltage to Current converter and Current to Voltage converter circuit consist of IC-741.	CO5	60	40	10
8.	Build/Test comparator circuit consist of IC-741 as Zero crossing detector and active positive peak detector.	CO5	60	40	10
9.	Build/Test Instrumentation amplifier circuit using IC LM324.	CO5	60	40	10
10.	Measuring of the bandwidth and cutoff frequency for a given first order low pass filter.	CO5	60	40	10
11.	Build and test 2nd order active low pass filter using IC-741 Op-Amp.	CO3	60	40	10
12.	Measuring of the bandwidth and cutoff frequency for a given first order high pass filter.	CO3	60	40	10
13.	Build and test a 2nd order active high pass filter using IC-741 Op-Amp.	CO3	60	40	10
14.	Build and test 2nd order active bandpass filter using IC-741 Op-Amp	CO3	60	40	10
15.	Build and test a 2nd order active band reject filter using IC-741 Op-Amp.	CO3	60	40	10
16.	Measuring of the frequency of oscillation for given RC Phase shift oscillator circuit using IC-741.	CO4	50	40	10
17.	Build and test Wien bridge oscillator circuit using IC-741 and Measure output frequency.	CO4	50	40	10
18.	Build/Test an astable multivibrator using IC-555 for the given specifications	CO4	50	40	10
19.	Build/Test monostable multivibrator using IC-555 for the given specifications.	CO4	50	40	10
20.	Build/Test an astable multivibrator using IC-555 for the given specifications	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, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Variable DC power supply	0-30V , 2A Dual Tracking power supply	ALL
2.	Dual Power supply	± 15V 2A Dual Tracking power supply	ALL
3.	CRO	0 to 20 MHz Dual Trace Oscilloscope & 100 MHz	ALL
4.	DSO	25 MHz/60 MHz/100 MHz 500MS/s to 1GS/s sample rate	ALL
5.	Function Generator	0- 2 MHz with sine , square and triangular output with variable frequency and amplitude	ALL
6.	Function Generator	20 MHz with sine , square and triangular output with variable frequency and amplitude	ALL
7.	Digital multimeter	4 ½ digit display , 9999 count, 0-30V, 10 A max , 0-100M Ohm	ALL
8.	Electronic Work Bench	Bread board 840 1000 contact point , positive & negative power rails on opposite side of the board	ALL
9.	IC 741C	Dual-In-Line or S.O. Package	ALL
10.	Breadboard	5.5 cm X 17 cm (minimum 1000 points)	ALL
11.	Resistors	82Ω, 1KΩ, 1.5KΩ, 3KΩ, 3.3KΩ, 10KΩ, 12KΩ, 15KΩ, 33KΩ, 39KΩ, 100KΩ	ALL
12.	Potentiometer	1KΩ, 10KΩ, 20KΩ, 50KΩ, 1MΩ	ALL
13.	Capacitors	0.01µF, 0.1µF, 1µF	ALL
14.	Diode	1N4007	ALL
15.	IC-555	8 Pin, DIP	ALL
16.	IC LM324	14 Pin, DIP	ALL
17.	Analog IC tester	Suitable to test analog ICs	ALL
18.	Connecting Wires	Single strained Teflon coating (0.6mm diameter)	ALL

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Microelectronic Circuits	Adel S.Sedra & Kenneth C Smith	Oxford, 2014 ISBN: 978019939266
2.	Linear Integrated Circuits	Salivahanan S	McGra Hill, New delhi, 2008 ISBN: 9780070648180
3	Linear Integrated Circuits	D.Roy Chaudhary, Jain, Sahil B .	New Age International Publishers, New delhi , 2003 ISBN:8122414702
4	Op-Amp and linear integrated circuits	Gayakwad , Ramakant A	PHI Learning , New Delhi,2011 ISBN : 9788120320581
5	Operational Amplifiers and Linear ICs	Bell, David A	Oxford university Press. New Delhi , India , 2011, ISBN: 9780195696134

(b) Online Educational Resources:

1) https://nptel.ac.in/courses/117107094
2) https://youtu.be/lpXNCwsnxjM?si=5U9VyrPe_zFcKMnx
3) https://youtu.be/9SnR3M3CIm4?si=tw9pou4CKS7MHsty

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

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A) Course Code : **2421402(T2421402/P2421402/S2421402)**

B) Course Title : Microcontroller and its Applications (ELX, ELX (R))

C) Pre- requisite Course(s) : Digital Electronics

D) Rationale:

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

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 performvarious activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Analyze the architecture of Microprocessor IC 8085.

CO-2 Analyze the architecture of Microcontroller IC 8051.

CO-3 Develop program for 8051 in assembly language for the specified operations.

CO-4 Develop program for 8051 using timer, Interrupt and serial or parallel ports.

CO-5 Interface the memory and I/O devices to 8051 for microcontroller-based applications.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ 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	-		
CO-2	3	2	2	-	-	2	-		
CO-3	3	3	2	3	-	2	-		
CO-4	3	3	2	3	-	2	-		
CO-5	3	2	1	3	2	2	2		

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	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				
Electronics Engineering	**2421402**	Microcontroller and its Applications	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:

Board of Study	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)	
Electronics Engineering	**2421402**	Microcontroller and its Applications	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: T2421402

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Interpret the general-purpose microprocessor and microcontroller. *TSO 1b.* Differentiate between microprocessor and microcontroller. *TSO 1c.* List different microcontrollers along with their typical features. *TSO 1d.* Develop simple program using 8085 instructions.	**Unit-1.0 Basics of Microprocessors and Microcontrollers** 1.1 Evolution of Processors (Microprocessors and Microcontrollers) 1.2 Microprocessors and Microcontrollers comparisons. 1.3 8085 Microprocessor: 1.3.1 Architecture & Pin Diagram 1.3.2 Register structure 1.3.3 8085 Addressing Modes 1.3.4 8085 Instruction set 1.3.5 Interrupt System	**CO1**
TSO 2a. Explain the architecture of 8051 microcontroller with block diagram representation. *TSO 2b.* Classify the different types of MCS-8051 registers. *TSO 2c.* Select the criteria for choosing a microcontroller. *TSO 2d.* Describe special function registers. *TSO 2e.* Explain the pin configuration of 8051 microcontroller with block diagram. *TSO 2f.* Explain memory organization of 8051 microcontroller. *TSO 2g.* Describe the Internal/External RAM & ROM organization of 8051 microcontroller.	**Unit-2.0 8051 Microcontroller** 2.1 Families of 8051 Microcontroller 2.2 Criteria for choosing a microcontroller 2.3 Block diagram representation 2.4 Pin configuration 2.5 Architecture 2.6 Registers: 2.6.1 General Purpose Registers 2.6.2 Stack Pointer and Program Counte 2.6.3 Special Function Registers (SFRs) 2.6.4 I/O Ports Structure 2.7 Memory Organization: 2.7.1 Internal/External RAM organization 2.7.2 Internal/External ROM organization	**CO1, CO2**
TSO 3a. Classify the different types of instruction used in 8051. *TSO 3b.* Differentiate addressing modes of 8051 microcontroller. *TSO 3c.* Explain the timer operation of 8051 microcontroller. *TSO 3d.* Differentiate between the serial and parallel communication modes of 8051. *TSO 3e.* Describe Interrupt handling in8051 microcontroller.	**Unit-3.0 Instruction Set and Addressing Modes of 8051 Microcontroller** 3.1 Instruction Set: 3.1.1 Data Transfer Instructions 3.1.2 Conditional instructions 3.1.3 Arithmetic instructions 3.1.4 Logical instructions 3.1.5 Boolean instructions 3.2 Different types of Addressing Modes: 3.2.1 Immediate Addressing Mode 3.2.2 Register Addressing Mode 3.2.3 Direct Addressing Mode 3.2.4 Indirect Addressing Mode 3.2.5 Indexed Addressing Mode 3.2.6 Relative Addressing Mode 3.2.7 Bit Addressing Mode 3.3 Timers/Counters: 3.3.1 Types of Timers/Counters 3.3.2 TMOD Register 3.3.3 TCON Register 3.4 Interrupts:	**CO3, CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.4.1 Types of interrupts 3.4.2 Interrupt handling	
TSO 4a. Difference between high level language and low-level language. *TSO 4b.* Select structure of Assembly language. *TSO 4c.* Explain the different microcontroller developing tools. *TSO 4d.* Explain different assembler directives. *TSO 4e.* Develop simple programs using 8051 instructions. *TSO 4f.* Develop timer interrupt routines for periodic tasks.	**Unit-4.0 8051 Microcontroller Assembly Language programming** 4.1Programming in Microcontroller 8051 4.1.1 Structure of Assembly language 4.1.2 Low level/ High level Language 4.1.3 Simple programming using instruction set 4.1.4 Timer and counter programming 4.2 Software Development Tools for 8051 Microcontroller 4.2.1 Editor 4.2.2 Assembler/Cross-Assembler 4.2.3 Compiler/Cross-Compiler 4.2.4 Debugger 4.2.5 Simulator	**CO3, CO4**
TSO 5a. Explain the interfacing of 8051 microcontroller. *TSO 5b.* Explain the keyboard interfacing with 8051 microcontrollers. *TSO 5c.* Develop program to interface 7-segment display with 8051 microcontrollers with sketch. *TSO 5d.* Develop program to interface sensor (e.g., temperature) with 8051 microcontrollers. *TSO 5e.* Develop program to interface LCD with 8051 with sketch. *TSO 5f.* Explain interfacing of ADC and DAC with 8051. *TSO 5g.* Develop program to control stepper motor with 8051.	**Unit 5.0 Interfacing of 8051 for Real Time Applications** 5.1 I/O Interfacing 5.2 ROM/RAM Interfacing 5.3 Keypad Interfacing 5.4 7-segment LED display interfacing 5.5 Sensor interfacing 5.6 LCD interfacing 5.7 ADC and DAC interfacing 5.8 Stepper motor interfacing	**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: P2421402

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Identify the various components in *8085* Trainer Kit.	1.	Verification of the features of 8085 Trainer Kit	CO1
LSO 2.1. Write an ALP for 8085 to add two 8-bit numbers. *LSO 2.2.* Test the results by executing the assembly language program.	2.	ALP based on Data transfer Instructions & Arithmetic Instructions(addition) in 8085	CO1
LSO 3.1. Write an ALP for 8085 to subtract two 8-bit numbers. *LSO 3.2.* Test the results by executing the assembly language program.	3.	ALP based on Data transfer Instructions and arithmetic Instructions(subtraction) in 8085	CO1
LSO 4.1. Identify the various components in 8051 Trainer Kit.	4.	Verification of the features of 8051 Trainer Kit	CO1, CO2
LSO 5.1. Write an ALP for 8051 to add two 8-bit numbers which is stored at two different memory locations and store	5.	ALP based on Data transfer Instructions & Arithmetic Instructions(addition) in 8051	CO3, CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
the result (with carry & without carry cases) at another memory location. *LSO 5.2.* Test the results by executing the assembly language program.			
LSO 6.1. Write and an ALP for 8051 to subtract two 8-bit Nos. which are stored at two different memory locations and store the result (with borrow & without borrow cases) at another memory locations. *LSO 6.2.* Test the results by executing the assembly language program.	6.	ALP based on Data transfer Instructions and arithmetic Instructions(subtraction) in 8051	CO3, CO4
LSO 7.1. Develop an assembly language program to generate delay using timer in 8051 Microcontroller. *LSO 7.2.* Test the results by performing assembly language program.	7.	Write an ALP to generate delay using Timer	CO3, CO4
LSO 8.1. Build a program to interface a 7-segment display with 8051 Microcontroller *LSO 8.2.* Test the results using an assembly language program.	8.	Interfacing 7 segment display with 8051	CO3, CO4, CO5
LSO 9.1. Build a program to interface a DC Motor with 8051 Microcontroller. *LSO 9.2.* Test the result using an assembly language program to interface DC Motor with 8051.	9.	Interfacing a DC Motor with 8051.	CO3, CO4, CO5
LSO 10.1. Build a program to interface a stepper Motor with 8051 Microcontroller. *LSO 10.2.* Test the results by performing an assembly language program to interface Stepper Motor with 8051.	10.	Interfacing a Stepper Motor with 8051	CO3, CO4, CO5
LSO 11.1. Build a program to interface 8-bit DAC with 8051 Microcontroller. *LSO 11.2.* Test the results by performing an assembly language program to interface 8-bit DAC with 8051.	11.	Interfacing 8-bit DAC with 8051	CO3, CO4, CO5

L) Suggested Term Work and Self Learning: S2421402 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. Two samples are given below:

1. Compare microprocessor with microcontroller on the basis of:
   - Architecture wise
   - Application wise
   - Based on Von Neumann or Harvard
2. Make chart on evolution of processors on the basis of company wise with processor name and year wise.

b. Micro Projects:

1. Design a microcontroller-based line follower robot.
2. Build android-controlled two-axis pick and place robot.
3. Develop home appliances controlling using android mobile via Bluetooth.
4. Build an android-based ultrasonic distance meter with buzzer indication.
5. Build speed control of DC motor using android mobile.

c. Other Activities:

1. Seminar Topics:
   - Li-fi Data Transfer System.
   - IOT Based Person/Wheelchair Fall Detection.
   - IOT based Smart Energy Meter Monitoring with Theft Detection.
   - Health Monitoring System using 7-Segment Display & At mega Microcontroller.
   - Importance of Microcontroller 8051

2. Visits: Visit nearby tool room/industry with proper facilities, some of which are given below and prepare report.
   - TRTC (Tool Room and Training Centre)
   - Automatic vehicle industry
   - Microcontroller Lab, IIT Patna

3. Self- learning topics:
   - ATMEL
   - ATMega microcontroller
   - Comparison between 8085 & 8086.
   - Applications of microcontrollers in electronic industry.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	15%	15%	-	-	15%	20%
CO-2	25%	20%	10%	25%	-	10%	20%
CO-3	25%	25%	15%	25%	33%	20%	20%
CO-4	15%	20%	30%	25%	33%	25%	20%
CO-5	15%	20%	30%	25%	34%	30%	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 Basics of Microprocessors and Microcontrollers	8	CO1	12	4	4	4
Unit-2.0 8051 Microcontroller	8	CO1, CO2	12	4	4	4
Unit-3.0 Instruction Set and Addressing Modes of 8051 Microcontroller	12	CO1, CO3	16	4	4	6
Unit-4.0 8051 Microcontroller Assembly Language Programming	10	CO1, CO2 CO4	16	4	6	6
Unit-5.0 Interfacing with Real Time Applications	10	CO1, CO2, CO5	14	4	6	6
Total	**48**	-	**70**	**20**	**24**	**26**

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

O) Suggested Assessment Table for Laboratory (Practical):

S.No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Verification of the features of 8085 Trainer Kit	CO1	40	50	10
2.	ALP based on Data transfer Instructions & Arithmetic Instructions(addition) in 8085	CO1	50	40	10
3.	ALP based on Data transfer Instructions and arithmetic Instructions(subtraction) in 8085	CO1	50	40	10
4.	Verification of the features of 8051 Trainer Kit	CO1, CO2	40	50	10
5.	ALP based on Data transfer Instructions & Arithmetic Instructions(addition) in 8051	CO3, CO4	50	40	10
6.	ALP based on Data transfer Instructions and arithmetic Instructions(subtraction) in 8051	CO3, CO4	50	40	10
7.	Write an ALP to generate delay using Timer	CO3, CO4	50	40	10
8.	Interfacing 7 segment display with 8051	CO3, CO4, CO5	60	30	10
9.	Interfacing a DC Motor with 8051.	CO3, CO4, CO5	60	30	10
10.	Interfacing a Stepper Motor with 8051	CO3, CO4, CO5	60	30	10
11.	Interfacing 8-bit DAC with 8051	CO3, CO4, CO5	60	30	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment	Broad Specifications	Relevant Experiment Number
1	Microcontroller Trainer kit	Single board systems with 8K RAM, ROM memory with battery backup, 16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler, RS- 232, USB, interfacing facility with built in power supply	All
2	PC with microcontroller simulation software	Desktop PC (above I5& 16GB RAM) with microcontroller simulation software	All
3	CRO/DSO	Bandwidth AC l0Hz ~ 20MHz (-3dB). DC~ 20MHz (-3dB), Xl0 Probe	All
4	Stepper Motor	50/100 RPM	10
5	Trainer board	Keyboard 4*4 trainer board	7 -11
6	7- segment LED Display	7-segment LED Display: - 0.56 in 1-digit, common anode/common cathode	8
7	Multimeter	Digital	8 -11
8	Trainer board	ADC (0808) trainer board	11
9	Trainer board	DAC (0808) trainer board	11
10	Trainer board	LCD trainer board	8
11	Sensors	LM35, ADXL345, AD590, BMP085, DT11, NTC, IIS3DWBTR, etc.	7

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh S. Gaonkar	Penram International Publishing (India) Private Limited, 5th Edition ISBN: 978-8187972099
2.	8051 Microcontroller Architecture Programming and Application	Kenneth J. Ayala	EEE/Prentice Hall of India, 2nd edition ISBN: 978-1401861582

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
3.	The 8051 Microcontroller and Embedded systems using Assembly and C	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinley	Pearson/Prentice Hall, 2nd edition, ISBN: 978-8177589030
4.	Microcontroller Principle and Application	Ajit Pal	Prentice Hall, India, New Delhi,2014, ISBN: 978-8120343924
5.	Microcontroller Theory and Application	Ajay Deshmukh	Tata McGraw Hill Pvt. Ltd., New Delhi, 2011, ISBN- 978-0070585959
6	Microcontroller Architecture Programming, Interfacing and System Design	Raj Kamal	Pearson Education India, ISBN13:978-8131759905

(b) Online Educational Resources:

1. Simulation software: www.keil.com
2. Simulation software: www.edsim51.com
3. Presentation: www.slideshare.net/aismahesh/memory-8051
4. Microcontroller: www.binaryupdates.com/switch-with-8051-microcontroller/
5. Microcontroller: https://www.8051projects.net/download-c4-8051-projects.html

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

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A) Course Code : **2421403(T2421403/P2421403/S2421403)**

B) Course Title : Digital Communication

C) Pre-requisite Course(s) : Principles of Electronic Communication, Analog and Digital Electronics

D) Rationale :

Digital communication is the backbone of the present telecommunication industry. No industry is untouched by digital communication. This course is designed to give good exposure of Digital Communication systems and Digital Communication techniques, and develop concepts to maintain more advanced communication systems. The concepts and principles of digital communication will also lay the foundation to understand the various modern communication systems.

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 Analyze different types of pulse modulation techniques.

CO-2 Test and interpret Pulse Code Modulated and Demodulated Signal.

CO-3 Compute the bandwidth and power requirement of basic digital modulation techniques namely ASK, PSK, and FSK.

CO-4 Interpret M-ary digital modulation techniques used to increase transmission data rate.

CO-5 Maintain Spread Spectrum based systems.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Electronics Engineering	**2421403**	Digital Communication	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

Board of Study	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)	
Electronics Engineering	**2421403**	Digital Communication	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 the 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: T2421403

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe the working of the given type of sampling technique with a suitable sketch. *TSO* 1b. Explain the effect of under-sampling for the given modulating signal. *TSO* 1c. Compare the given parameters of different pulse analog modulation techniques (PAM, PWM and PPM).	**Unit 1.0 Pulse Analog Modulation Techniques** 1.1 Sampling Theory: Sampling theorem in time and frequency domain, Aliasing phenomenon, Sampling techniques (Ideal, Natural, and Flat top), aperture effect and equalization 1.2 Pulse Modulation: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Basic definition, generation and detection procedure, waveform, advantages, disadvantages and applications	**CO1**
TSO 2*a.* Describe the advantages of given digital pulse modulation technique. *TSO* 2b. Explain the quantization procedure with example. *TSO* 2c. Compare the various parameters of digital pulse modulation techniques (PCM, DPCM, and DM). *TSO* 2d. Explain the need for companding at transmitter and receiver.	**Unit 2.0 Pulse Digital Modulation** 2.1 Advantages and Disadvantages of Digital Communication, Quantization, Uniform and Non-uniform quantization, Pulse Code Modulation (PCM): generation and detection. 2.2 Noise consideration in PCM, companding 2.3 Differential Pulse Code Modulation (DPCM), Delta Modulation (DM), Adaptive Delta Modulation (ADM)generation, detection, applications. 2.4 Time Division Multiplexing (TDM) for pulse modulation systems.	**CO2**
TSO 3a. Interpret the modulated waveform for the given type of digital bandpass modulation scheme. *TSO* 3b. Describe the function of the given block of the BASK, BFSK and BPSK transmitter. *TSO* 3c. Describe the procedure to demodulate BASK, BFSK and BPSK Signal using coherent and non-coherent detection. *TSO* 3d. Calculate the bandwidth required for the given type of binary modulation technique. *TSO* 3e. Calculate the power required for the given type of binary modulation technique.	**Unit-3.0 Digital Band Pass Modulation Techniques** 3.1 Principles of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK) Generation and Detection, bandwidth and power requirement, coherent and non-coherent detection technique 3.2 Concepts of binary modulation techniques, Binary ASK(BASK), Binary FSK(BFSK) and Binary PSK(BPSK) 3.3 Comparison of ASK, FSK and PSK	**CO3**
TSO 4a. Describe with sketch the given type of phase shift keying generation and detection technique. *TSO* 4b. Describe the generation and detection of QAM with the help of block diagram. *TSO* 4c. Explain working of the given type of M-ary transmitter and receiver with the help of a block diagram. *TSO* 4d. Describe the given type of M-ary digital bandpass modulation technique.	**Unit-4.0 Other Digital Modulation Techniques** 4.1 BPSK, DPSK, and QPSK, generation and detection 4.2 Quadrature Amplitude Modulation (QAM) & Minimum Shift Keying (MSK) 4.3 M-ary digital modulation scheme (M-ary PSK, M-ary QAM, M-ary FSK) varactor diode and Voltage Controlled Oscillator (VCO)	**CO4**
TSO 5a. Differentiate between standard narrowband and spread spectrum communication system. *TSO* 5b. Interpret the aspects of spread spectrum (SS)	**Unit-5.0 Spread Spectrum Modulation** 5.1 Introduction to spread pectrum (SS)modulation: advantages over fixed frequency,	**CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
modulation for the given application. *TSO* 5c. Compare the spread spectrum approach in the frequency domain and in time domain with the help of suitable illustrations. *TSO* 5d. Describe the types of spread spectrum modulation formats (FHSS & DSSS). *TSO* 5e. Generate PN sequence for the given length of data bits.	applications of SS modulation, block diagram of spread spectrum modulation system 5.2 Frequency Hopping Spread Spectrum, (FHSS) System, Application of FHSS, fast and low frequency hopping 5.3 Direct Sequence Spread Spectrum (DSSS), Features, generation and detection of DSSS 5.4 Pseudo Noise (PN) sequence: definition, generation, and maximum length sequence	

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2421403

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
LSO1.1 Interpret the Modulated and demodulated waveform of PAM.	1	Test the performance of Pulse Amplitude Modulation (PAM) and Demodulation circuit	CO1
LSO 2.1 Interpret the modulated and demodulated waveform of PWM	2	Test the performance of PWM modulation and demodulation circuit	CO1
LSO 3.1 Interpret the modulated and demodulated waveform of PPM.	3	Test the performance of PPM modulation and demodulation circuit	CO1
LSO 4.1 Interpret Pulse Code Modulated (PCM) and demodulated waveforms for different sampling and modulating frequencies.	4	Generate and trace the Pulse Code Modulated (PCM) and demodulated waveforms for different sampling and modulating frequency	CO2
LSO 5.1 Generate the modulation and demodulation waveform of Delta Modulated circuit. LSO 5.2 Analyze the effect of granular and slope overload noise from the modulated waveforms.	5	Test the performance of the DM circuit	CO2
LSO 6.1 IInterpret the modulation and demodulation waveform of Adaptive Delta Modulated circuit. *LSO* 6.2 Compare the effect of noise in DM and ADM circuit.	6	Test the performance of ADM circuit	CO2
LSO 7.1 Generate the demodulation waveform from ASK trainer kit. *LSO* 7.2 Measure the bandwidth in ASK demodulated waveform. *LSO* 7.3 Analyze the probability of error in ASK demodulated waveform	7	Test the performance of ASK modulator and demodulator circuit	CO3
LSO 8.1 Generate the demodulation waveform from FSK trainer kit. *LSO* 8.2 Measure the bandwidth in FSK demodulated waveform. *LSO* 8.3 Analyze the probability of error in FSK demodulated waveform	8	Test the performance of the FSK modulator and demodulator circuit	CO3
LSO 9.1 Generate the demodulation waveform from PSK circuit. *LSO 9.2* Measure the required bandwidth in PSK demodulated waveform. *LSO 9.3* Analyze the probability of error in PSK	9	Test the performance of PSK modulator and demodulator circuit	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number (s)
demodulated waveform			
LSO 10.1 Generate the demodulation waveform from QPSK circuit. *LSO 10.2* Measure the required bandwidth in QPSK demodulated waveform. *LSO 10.3* Analyze the probability of error in QPSK demodulated waveform	10	Test the performance of QPSK modulator and demodulator circuit	CO4
LSO 11.1 Apply different message signals to modulate and QAM trainer kit. *LSO 11.2 Generate* the demodulation waveform from QAM signal. *LSO 11.3 Measure* the required bandwidth in QAM /demodulated waveform.	11	Test the performance of QAM modulator and demodulator circuit	CO4
LSO 12.1 Interpret the PN sequence and FHSS generate the modulated and demodulated waveform.	12	Test the performance of Frequency Hopping Spread Spectrum (FHSS) Modulation and Demodulation circuit	CO5
LSO 13.1 Use PN sequence to generate DSSS modulated signal	13	Test the output of generation and demodulation circuit of the DSSS modulated signal	CO5

L) Suggested Term Work and Self-Learning: S2421403 Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

a. Assignments:

i. Compare PAM, PPM, and PWM techniques.
ii. Explain the necessity of sampling for the modulation process.
iii. Differentiate between the effect of noise in DM and DPCM.
iv. Explain the necessity of non-uniform quantization with justification.
v. Compare characteristics parameters of BASK, BFSK and BPSK
vi. List the applications of M-ary modulation scheme.
vii. Describe how spread spectrum is used for GPS.

b. Micro Projects:

I. Prepare a chart to show the generation and detection of various types of pulse modulation techniques.
II. Develop and test a circuit to generate a pulse position modulated signal for the specified parameters.
III. Demonstrate Time Division Multiplexing and de-multiplexing process for Pulse Amplitude Modulated signals.
IV. Prepare a chart to demonstrate the various encoding schemes for a given digital data stream.
V. Generate Binary Phase shift keying signals using MATLAB/Scilab software.
VI. Prepare a chart to show a performance comparison of digital modulation schemes.
VII. Prepare a report on Spread spectrum based communication systems.

c. Other Activities:

1. Seminar Topics:

I. Modulation techniques for mobile communication.
II. Applications of PCM and other digital modulation techniques.
III. Sample and Hold circuit to check the flat top sampled signal.
IV. Generation of ASK signal for two different bit patterns.
V. Application of CDMA in cellular communication.

2. Visits**:** Visit nearby radio stations/Doordarshan Kendra/ mobile service centers/telecommunication industry. Prepare a report of the visit with special comments on types of digital transmitters receivers used various frequency bands used.
3. Self-learning topics:

   i. Explain the procedure to avoid aliasing.
   ii. List the major drawbacks of digital communication.
   iii. Describe the advantages of ASK technique and compare it with other keying techniques.
   iv. Performance comparison of QPSK and QAM.
   v. Define throughput, process gain, chip rate, and jamming margin of any PN sequence.
   vi. Compare slow and fast hopping.

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 **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%	10%	10%	20%	20%
CO-2	30%	30%	30%	25%	25%	40%	20%
CO-3	30%	30%	30%	25%	25%	40%	20%
CO-4	10%	20%	10%	20%	10%	10%	20%
CO-5	15%	10%	15%	10%	10%	20%	20%
Total Marks	**30**	**70**	**20**	**20**	**10**	**20**	**30**
			50				

Legend:
*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
**: Mentioned under point- (N)
#: Mentioned under point-(O)

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

N) Suggested Specification Table for End Semester Theory Assessment: The specification table represents the reflection of sample representation of assessment of the cognitive domain of the 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 Pulse Analog Modulation Techniques	8	CO1	12	4	4	4
Unit-2.0 Pulse Digital Modulation	11	CO2	16	4	6	6
Unit-3.0 Digital Band Pass Modulation Techniques	11	CO3	16	4	6	6

Unit-4.0 Other Digital Modulation Techniques	8	CO4	10	2	4	4
Unit-5 Spread Spectrum Modulation	10	CO5	14	4	4	6
Total Marks	**48**	-	70	20	24	26

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Test the performance of Pulse Amplitude Modulation (PAM) and Demodulation circuit	CO1	50	40	10
2.	Test the performance of PWM modulation and demodulation circuit	CO1	50	40	10
3.	Test the performance of PPM modulation and demodulation circuit	CO1	50	40	10
4.	Generate and trace the Pulse Code Modulated (PCM) and demodulated waveforms for different sampling and modulating frequency	CO2	50	40	10
5.	Test the performance of DM circuit	CO2	50	40	10
6.	Test the performance of ADM circuit	CO2	50	40	10
7.	Test the performance of ASK modulator and demodulator circuit	CO3	50	40	10
8.	Test the performance of FSK modulator and demodulator circuit	CO3	50	40	10
9.	Test the performance of the PSK modulator and demodulator circuit	CO3	50	40	10
10.	Test the performance of the QPSK modulator and demodulator circuit	CO4	50	40	10
11.	Test the performance of the QAM modulator and demodulator circuit	CO4	50	40	10
12.	Test the performance of Frequency Hopping Spread Spectrum (FHSS) Modulation and Demodulation circuit	CO5	50	40	10
13.	Test the output of the generation and demodulation circuit of DSSS modulated signal	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 practicals. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student's 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 Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs, etc.

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number (s)
1.	Trainer Kit for generation and detection of PAM, PWM & PPM	Power Supply 110 – 240 V, 50Hz, Lab Manuals with detail	1,2,3
2.	PCM, DPCM, DM and ADM Trainer kit	Power Supply 110 – 240 V, 50Hz, Lab Manuals with detail	4,5,6
3.	ASK, FSK and PSK Trainer Kit for generation and detection	Power Supply 110 – 240 V, 50Hz, Lab Manuals with detail	7,8,9
4.	FHSS and DSSS Trainer Kit	Power Supply 110 – 240 V, 50Hz, Lab Manuals with detail	12,13
5.	QPSK and QAM Trainer Kit	Power Supply 110 – 240 V, 50Hz, Lab Manuals with detail	10,11
6.	Variable DC Power Supply	Output: -15 to +15V (Variable), 0 – 5A	All
7.	Digital Oscilloscope	Bandwidth 50MHz to 100MHZ,Real-time Sampling Rate at least 500 MSa/s, Equivalent Sampling Rate 50GSa/s., Memory Depth: 32Kpts, Trigger types: Edge, Pulse width, Video, Slope, Alternative, Digital Filter function and Waveform Recorder function, Support pass/fail function, Auto Measure function, Save/recall types: Setups, Waveforms, CSV file, Picture, Waveform Intensity, and grid brightness can be adjusted, Standard configuration port: USB Host: Support USB flash driver save/recall function and update firmware, USB Device: Support PICT Bridge compatible printer and support PC remote control, RS232	1,2,3,7,8,9,10,11,12, 13
8.	Function Generator	Signals of choice up to at least 50 MHz with sine , square, and triangular wave output with variable frequency and amplitude	1,2,3,7,8,9,10,11,12, 13
9.	Spectrum Analyzer	Frequency range up to 1 GHz Resolution Bandwidth: 1 Hz to 8 MHz Noise Floor/Dynamic range: -163 dBm to +30 dBm	1,2,3,7,8,9,10,11

R) Suggested Learning Resources:

(a) Books:

Sl. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Electronic Communication Systems	Kennedy George, Davis Bernard, Prasanna SRM	McGraw Hill, 5th edition, 2011 ISBN-13: 978-0071077828
2.	Modern Digital and Analog Communication Systems	B. P. Lathi, Zhi Ding	Oxford University Press, 2010, 4th edition ISBN- 13: 978-0198065340
3.	Communication Systems	Simon Haykin, Michael Moher	Wiley, 2009, 5th edition ISBN-13: 978-8126521517
4.	Principles of Communication Systems	Taub H., Schilling D.L., Saha G	Tata Mc Graw Hill, Fourth Edition, ISBN- 13:978-1259029851
5.	Digital Communication	Muralidhar Kulkarni and K.S. Shivaprakash	AICTE, January 2023 ISBN- 978-81-960576-3-3

(b) Online Educational Resources:

1. Video lecture: -www.nptelvideos.in/communication engineering.
2. Digital Modulation technique: -https://www.youtube.com/watch?v=GLnGVB92K78
3. Digital Communication: -https://www.slideshare.net/lineking/digital-communicationsystem?
4. Digital communication tutorial: - http://www.nptelvideos.in/2012/12/digitalcommunication.html
5. Data communication and Networking: - http://datacombasic.blogspot.in/2011/03/e-and-tcarrier.html
6. http://electronicdesign.com/communications/understanding-modern-digital-modulation-techniques

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. Digital Communication Users' Guide
2. Digital Communication Techniques Engineering Handbook
3. Lab Manuals

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A) Course Code : **2421404(P2421404/S2421404)**

B) Course Title : Electronic Equipment Maintenance

C) Pre- requisite Course(s) : Electrical & Electronics Workshop, Basic Electronics Engineering, Analog Electronics, Digital Electronics

D) Rationale :

Equipment with electronic circuits are extensively being used invariably in all types of industries. The maintenance of these equipment/devices is very essential as it not only increases the life of the equipment but also makes the system reliable. This course is being designed in such a way that the experiences in this course will enable the students to develop skills to maintain the analog and digital components and circuits, trouble shoot and repair commonly used domestic appliances and other electronic systems used in industry and consumer goods. This course will be able to develop the cognitive, psychomotor and affective domain skills, which will enable the diploma students to get acquainted with the maintenance issues which they will face in the industries but also to become self employed by starting the electronic repairing and maintenance shop of their own. The Electronic Equipment Maintenance practice part is accomplished through practical experiences for which appropriate assessment criteria will have to be developed by the teacher depending upon the experience.

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

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

CO-1 Use the tools and equipment required to perform functional testing and maintenance of electronic devices.

CO-2 Troubleshoot the analog circuits.

CO-3 Troubleshoot the digital circuits.

CO-4 Troubleshoot the common faults in Surface Mount Assembly.

CO-5 Maintain the electronic home appliances.

CO-6 Troubleshoot different electronic systems for smooth operation.

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

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	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				
Electronics Engineering	**2421404**	Electronic Equipment Maintenance	-	-	04	02	06	03

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:

Board of Study	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)	
Electronics Engineering	**2421404**	Electronic Equipment Maintenance	-	-	20	30	20	30	100

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 (Include assessment related to student performance in assignments, seminars, microprojects, 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:

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between Maintenance and troubleshoot of electronic equipment/device *TSO 1b.* Analyze the cause of failure in a given electronic equipment/device. *TSO 1c.* Describe the steps to use fault-finding aids/tools and instruments for troubleshooting a given electronic equipment/device. *TSO 1d.* Explain troubleshooting techniques to troubleshoot the given electronic equipment/device.	**Unit-1.0 Basics of Maintenance and Troubleshooting of Electronic Equipment** 1.1 Fundamental difference between Maintenance and troubleshoot 1.2 Causes of failure in equipment -Improper circuit design, manufacturing deficiencies, improper or negligent handling and operating, Environmental factors 1.3 Nature of faults, fault location procedure 1.4 Fault finding aids – Interpretation of drawings/Block/Circuit/wiring Diagram; Dis-assembly and re-assembly of equipment, Operation/instruction manuals, Service and maintenance manuals, concept of warranty and guarantee, equipment service options 1.5 Fault finding tools and instruments 1.6 Troubleshooting techniques- Approaching components for tests, Grounding systems in Electronic Equipment, Temperature sensitive Intermittent problems Corrective actions, Situations where repairs should not be attempted	**CO1**
TSO 2a. Describe procedure for testing a given electronic component. *TSO 2b.* Describe the steps to troubleshoot the common symptoms and failures in the given analog circuit.	**Unit-2.0 Troubleshooting of Analog Circuits** 2.1 Testing of passive components and circuits- Resistors, Inductors and Capacitors • Failure in resistor– fixed and variable resistors-potentiometer, LDR and thermistor, Failure, test and servicing of potentiometer • Failure in Inductors-testing, measurement, failure detection and servicing • Failure in Capacitors -Types and their performance, testing and measurement, failure detection and servicing 2.2 General troubleshoot procedure of Passive Filters: Low Pass, High Pass, Band stop, Band pass Filter	**CO2, CO1**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.3 Failure and fault diagnosis of active components - Semiconductor devices, diodes, special types of diodes, Bipolar Junction Transistors, Field Effect Transistors, Thyristors, Operational Amplifiers 2.4 Fault diagnosis and General troubleshoot procedure for analog circuits - Diode half-wave, Centre Tapped full wave and full wave Bridge Rectifier, BJT Amplifiers-CE, CB and CC Amplifier	
TSO 3a. Describe the steps to troubleshoot the common symptoms and failures in the given digital circuit. *TSO 3b.* Describe steps for testing of on-board ICs.	**Unit- 3.0 Troubleshooting of Digital Circuits** 3.1 TTL and CMOS ICs 3.2 Packages in digital ICs, IC identification, IC pin-outs, Handling ICs 3.3 Digital troubleshooting methods – Typical faults, testing digital ICs with pulse generators Logic clip, Logic Probe, Logic Pulser, Logic Current Tracer, Logic Comparator 3.4 Special consideration for fault diagnosis in digital circuits 3.5 Handling precautions for ICs, sensitive to static electricity 3.6 Testing flip-flops, counters, registers, multiplexers and de-multiplexers, encoders and decoders; Tri-state logic 3.7 Testing of ICs connected on given PCB	**CO3, CO1**
TSO 4a. Differentiate between SMT and SMD. *TSO 4b.* Analyze different types of Surface Mount semiconductor Packages. *TSO 4c.* Identify different types of IC packages. *TSO 4d.* Describe the steps to troubleshoot t the common faults in the given Surface Mount Assembly.	**Unit-4.0 Troubleshooting of Surface Mount Assemblies** 4.1 Surface Mount Technology (SMT) and Surface Mount Devices (SMD) 4.2 Surface Mount Semiconductor packages – Small-outline IC (SOIC), Small-outline Transistor (SOT), Leadless Ceramic Chip Carrier (LCCC), land grid array (LGA), Ball-grid Array (BGA), Chip-on-board (COB) 4.3 IC Packages and types - Flatpacks and Quad Packs, Cylindrical Diode Packages, Packaging of Passive Components as SMDs 4.4 Troubleshooting techniques-Repairing Surface Mount PCBs, Rework Stations	**CO4, CO1**
TSO 5a. Describe the maintenance procedure of the given electronic domestic appliance for smooth working. *TSO 5b.* Describe the steps to troubleshoot the common symptoms and failures in the given electronic domestic appliance.	**Unit-5.0 Maintenance and Repair of Electronic Domestic Appliances** 5.1 Kitchen stoves (Cooking range), microwave ovens and induction cookers 5.2 Battery charger, emergency light systems, Inverter 5.3 Water level controller, Water Purifier	**CO5, CO4, CO3, CO2, CO1**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	5.4 Air conditioners 5.5 Washing machines, clothes dryers, Dishwashers 5.6 Liquid Crystal Display (LCD) Television Receiver, Light Emitting Diode (LED) Television Receiver 5.7 Car Stereo System 5.8 Refrigerators and Freezers	
TSO 6a. Describe the maintenance procedure of the given electronic system. *TSO 6b.* Describe the repairing procedure of the given electronic system. *TSO 6c.* Identify the given type of data cable/connector along with its' function.	**Unit-6.0 Maintenance and Repairs of common Electronic Systems** 6.1 Power supply Circuits – Types of Regulators, Power Supply Troubleshooting, SMPS, High Voltage DC Power supplies, UPS 6.2 Oscilloscope – Fault Diagnosis chart, CRT replacement 6.3 Function generator- Troubleshooting and maintenance 6.4 Cordless Telephone –Troubleshooting and maintenance of cordless telephone 6.5 Mobile Phone – faults in microphone, earpiece, ringer, vibrator and solutions 6.6 Data cables and connectors - Testing and identification of different types of data cables: Ethernet cables, coaxial cable, serial and parallel cables, telephone cable, USB cable; and connectors. 6.7 Computer System: Assembling a computer system, Maintenance and Repair procedure of computer system 6.8 Data projectors 6.9 Surveillance system- CCTV 6.10 Public address (PA) system	**CO6, CO5, CO4, CO3, CO2, CO1**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2421404

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Identify common fault-finding tools and instruments for maintaining a given electronic equipment. *LSO 1.2.* Use common fault-finding tools and instruments for maintaining a given electronic equipment.	1.	Identification of common fault-finding tools and instruments and their function	CO1
LSOs 2.1 Test the given fixed/variable passive electronic component. *LSOs 2.2* Prepare the specification chart of given passive electronic component.	2.	Performance of different passive electronic components	CO2, CO1
LSO 3.1. Test the given active electronic component like general purpose transistor/FET/MOSFET/SCR/DIAC/TRIAC	3.	Performance of different active electronic components	CO2, CO1

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
with DMM and CRO OR Components Tester. *LSO 3.2.* Prepare the specification chart of given active electronic component.			
LSO 4.1 Identify various ICs (analog and digital) like OP-Amp, Voltage regulator, power amplifier, PLL, VCO. *LSO 4.2* Test various ICs using IC tester.	4.	Functionality of general-purpose analog IC's using IC tester	CO2, CO1
LSO 5.1. Verify the functionality of TTL and CMOS Digital IC's using IC tester. *LSO 5.2.* Test various digital ICs using IC tester.	5.	Functionality of TTL and CMOS Digital IC's using IC tester	CO3, CO2
LSO 6.1. Identify the SMD tools required for SMD soldering.	6.	Identification of SMD tools required for SMD soldering	CO4, CO1
LSO 7.1. Demonstrate different SMT soldering methods - Hand Soldering, Hot Air Soldering and Hot Plate Soldering.	7.	Demonstration of different soldering methods	CO4, CO1
LSO 8.1. Demonstrate locating the common faults in SMT.	8.	Demonstration of locating common faults in SMT such as Solder balls, Solder beading, Bridging, Open- Insufficient fillet, voiding, Tombstoning, Un melted solder paste, Disturbed or cold joint, joint Excess solder on filet, Slump, Non-wetting, De-wetting and Orange Skinning	CO4, CO1
LSO 9.1 Demonstrate the maintenance of a given electronic domestic appliance for its smooth functioning. *LSO 9.2* Perform accurate fault diagnosis of the given electronic domestic appliance	9.	Demonstration of locating common faults in a given electronic domestic appliance (***Minimum Five types***) • Kitchen stoves (Cooking range), microwave ovens and induction cookers • Battery charger, emergency light systems, Inverter • Water level controller, Water Purifier • Air conditioners • Washing machines, clothes dryers, Dishwashers • Liquid Crystal Display (LCD) Television Receiver, Light Emitting Diode (LED) Television Receiver • Car Stereo System • Refrigerators and Freezers	CO5, CO4, CO3, CO2, CO1
LSO 10.1. Demonstrate the maintenance of a given common electronic system for its smooth functioning. *LSO 10.2.* Troubleshoot the given common electronic system for simple faults.	10.	Demonstration of maintenance and repair work of a given common electronic system for its smooth functioning ***(Minimum Five types)*** • Power supply Circuits • Oscilloscope • Function generator • Cordless Telephone • Mobile Phone • Data projectors • Surveillance system- CCTV • Public address (PA) system	CO6, CO4, CO3, CO2, CO1

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 11.1. Test the given data cables. *LSO 11.2.* Test the given data connectors.	11.	Testing of the specified data cables and connectors	CO6, CO1
LSO 12.1. Demonstrate the maintenance and repair work in a given computer system.	12.	Demonstration of maintenance of computer system	CO6, CO5, CO4, CO3, CO2, CO1

L) Suggested Term Work and Self Learning: S2421404 Some sample suggested assignments, micro projects 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 a line diagram to install an inverter for a residence.
2. Diagnose fault in the faulty appliance/equipment/device at home/college/hostel and rectify it.
3. Write a case study which is helpful in fault detection and rectification of the problem in an electronic system.
4. Prepare a chart indicating the common faults in SMT, their symptoms and remedies
5. Prepare a chart indicating the various tools and instruments commonly used for repairs and maintenance of an Electronic system
6. Prepare a chart indicating the parts of a computer system which requires maintenance

b. Micro Projects:

1. Given the circuit/schematic diagram, interpret the symbols used in the diagram correctly.
2. Diagnose precisely the faults in a diode full wave bridge rectifier and make it functional. Prepare a report and submit.
3. Diagnose precisely the faults in a digital circuit and make it functional. Prepare a report and submit
4. Troubleshoot a surface mount PCB and make it functional.
5. Diagnose fault in the nonworking home appliance and rectify it.
6. Diagnose malfunction in the given CRO and rectify it.

c. Other Activities:

1. Seminar Topics:
   - Principle of operation of common domestic appliances
   - Common faults in domestic appliance
   - Testing and fault-finding tools and techniques
   - Using supplier's manual for operation and troubleshoot/maintenance

2. Visits: Visit nearby toolroom/ electronic service industry. Prepare report of visit with special comments on electronics equipment's and its maintenance.

3. Self-learning topics:
   - Automated Test Equipment in Electronic Maintenance and Repairs
   - Tools in Electronic Maintenance and Repairs
   - Materials used in Electronic Maintenance and Repairs

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	-	-	10%	10%	50%	15%	15%
CO-2	-	-	20%	15%		20%	20%
CO-3	-	-	20%	15%		20%	20%
CO-4	-	-	10%	15%	50%	15%	15%
CO-5	-	-	20%	25%		15%	15%
CO-6	-	-	20%	25%		15%	15%
Total Marks	-	-	**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: (Not Applicable)

O) Suggested Assessment Table for Laboratory (Practical):

S.No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Identification of common fault-finding tools and instruments and their function	CO1	35	45	20
2.	Performance of different passive electronic components	CO2, CO1	35	45	20
3.	Performance of different active electronic components	CO2, CO1	35	45	20
4.	Functionality of general-purpose analog IC's using IC tester	CO2, CO1	35	45	20
5.	Functionality of TTL and CMOS Digital IC's using IC tester	CO3, CO2	35	45	20
6.	Identification of SMD tools required for SMD soldering	CO4, CO1	35	45	20
7.	Demonstration of different soldering methods	CO4, CO1	35	45	20
8.	Demonstration of locating common faults in SMT such as Solder balls, Solder beading, Bridging, Open- Insufficient fillet, voiding, Tombstoning, Un melted solder paste,	CO4, CO1	35	45	20

S.No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	Disturbed or cold joint, joint Excess solder on filet, Slump, Non-wetting, De-wetting and Orange Skinning				
9.	Demonstration of locating common faults in a given electronic domestic appliance ***(Minimum Five types to be performed)*** • Kitchen stoves (Cooking range), microwave ovens and induction cookers • Battery charger, emergency light systems, Inverter • Water level controller, Water Purifier • Air conditioners • Washing machines, clothes dryers, Dishwashers • Liquid Crystal Display (LCD) Television Receiver, Light Emitting Diode (LED) Television Receiver • Car Stereo System • Refrigerators and Freezers	CO5, CO4, CO3, CO2, CO1	35	45	20
10.	Demonstration of maintenance and repair work of a given common electronic system for its smooth functioning ***[Details in point J) (Minimum Five types to be performed)]*** • Power supply Circuits • Oscilloscope • Function generator • Cordless Telephone • Mobile Phone • Data projectors • Surveillance system- CCTV • Public address (PA) system	CO6, CO4, CO3, CO2, CO1	35	45	20
11.	Testing of the specified data cables and connectors	CO6, CO1	35	45	20
12.	Demonstration of maintenance of computer system	CO6, CO5, CO4, CO3, CO2, CO1	35	45	20

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

Note: This table be used for both end semester as well as 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.	Dual Power Supply	0-30 V, 2A	All
2.	Multimeter	Digital	All
3.	LCR meter	Digital	All
4.	Cathode Ray Oscilloscope	Dual Trace 50MHz and above, 1MΩ input impedance	All
5.	Function Generator	0-2 MHz with sine, square and triangular wave output with variable frequency and amplitude	All
6.	Signal Generator	0-100 KHz	All
7.	Digital IC tester	Test a wide range of Digital IC's such as 74 series, 40/45 series of CMOS IC's microcontroller, memories	5
8.	Analog IC tester	Test the general-purpose analog IC's: OP-Amp, Voltage regulator, power amplifier, PLL, VCO	4
9.	SMD SOLDERING EQUIPMENT	Comprising of • soldering iron with a fine tip and a brass sponge. • thin solder is your friend, pref. 0.4 – 0.6mm. • SMD tweezers. • desoldering braid to the rescue! • desk lamp. • magnifying glass. • SMD storage box	6,7,8
10.	Cables/connectors	Different types of electronic and electrical cables, connectors, sockets, terminations.	11
11.	Television set	21" LCD and LED	9
12.	Projector	Lens, F=1.80, Focal Length 3.71mm, Display resolution 1920 x 1080 Pixels	9
13.	Online UPS	10KVA with 65 Ah Battery Bank	10
14.	Personal Computer	4GB RAM, 500GB HDD, higher Processor	12
15.	Maintenance kit	Logic probe, logic pulser, current tracer, soldering iron: 25 W, 240 V, with solder materials, Soldering Iron Changeable bits 10 W, De- soldering pump, Neon tester:500 V, etc.	9 to 12
16.	Tools	Screw driver set (set of 5) , Insulated combination pliers: 150 mm, Insulated side cutting pliers: 150 mm ,Long nose pliers: 150 mm ,Electrician knife , Tweezers: 100mm, Crimping tool (pliers), Allen key set (set of 9), Magnifying lenses: 75mm with illumination, Continuity tester	9 to 12
17.	Vacuum Cleaner/Blower	Cordless, 500 W	12
18.	Components	Passive components, analog and digital ICs, general purpose PCBs, bread board, etc.	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Trouble Shooting Electronic Equipment: Includes repair and Maintenance	Khandpur, R. S.	McGraw Hill Publishing, New Delhi, 2014, ISBN: 978-0070483576
2.	Trouble Shooting & Maintenance of Electronic Equipment	Singh, K. Sudeep	Katson Book, New Delhi, Reprint 2013, ISBN: 978-8188458639
3.	Hand book of repair and maintenance of domestic electronic appliances	Sinha, Sakshi Bhushan	BPB Publications, New Delhi, 2016, ISBN: 978-8183335027
4.	Electronic instrument and systems: Principles, Maintenance and Troubleshooting	Gupta, R. G	McGraw Hill Publishing, New Delhi,2014, ISBN: 978-0074636299
5.	Consumer Electronics	Bali, S. P.	Pearson Education India ISBN: 978-8131717592, 8131717593
6.	The Complete PC Upgrade & Maintenance guide	Mark, Minasi	Willey Publication, New Delhi 2010, ISBN:978-8126506279

(b) Online Educational Resources:

1) www.ifixit.com
2) www.talkingelectronics.com
3) www.computerhope.com/basic.html
4) www.accessify.com
5) www.esim.fossee.in
6) www.fastrepairguide.com
7) www.repairfaq.org
8) www.linear.com
9) www.easyeda.com
10) www.circuitlogix.com
11) www.spectrum-soft.com
12) https://www.eit.edu.au/resources/practical-troubleshooting-of-electronic-circuits-for-engineers-and-technicians/
13) https://www.topline.tv/SMT_Nomenclature.pdf
14) https://cbseacademic.nic.in/web_material/Curriculum/Vocational/2017/Troublshooting_Inside.pdf
15) https://www.maritimeknowledge.in/coursedetails.php?course_id=174&course_name=Maintenance%20and%20repair%20of%20electrical%20and%20electronic%20equipment#
16) https://www.cstaricalcutta.gov.in/images/ATS-MRAMOETE-NSQF-5.pdf
17) https://www.mouser.com/pdfDocs/mgelecmaintcatalogweb.pdf

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. A Handbook on Measuring Instruments: The Blue Book (Part 1,) Kindle Edition
2. Calibration Handbook of Electronics Equipment's and maintenance
3. Instruments user guide
4. Student Reference Manual for Electronic Instrumentation Laboratories by Stanley Wolf, and Richard F. M. Smith, Prentice Hall of India Pvt. Ltd,. New Delhi
5. I.S. Codes, Bureau of Indian Standards, New Delhi

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A) Course Code : **2418305(T2418305, P2418305,S2418305)**

B) Course Title : Python Programming

(CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT, RE)

C) Pre- requisite Course(s) :

D) Rationale :

Python programming has emerged as a popular programming language across wide range of application segments from Scientific to Machine Learning to mobile app development, and so on. Python is a high-level general-purpose programming language.

Because code is automatically compiled to byte code and executed, Python is suitableuse as a scripting language, Web application implementation language, etc.
In Python there are multiple levels of organizational structure: functions, classes, modules, and packages. These assist in organizing code. An excellentand large example is the Python standard library.

The Object-oriented Python provides a consistent way to use objects: in Python it is easy to implement new object types (called classesin object-oriented programming).
This introductory course to learn basic Python programming features which can be used as building blocks to develop different kind of applications using Python 3.

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

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

CO-1 Use various data types and operators in formation of expressions.
CO-2 Write and execute programs using control statements.
CO-3 Perform relevant operations on Sequence data types
CO-4 Create functions in modules
CO-5 Use numpy in writing python programs
CO-6 Handle data files and exceptions.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2418305	Python programming	03	-	04	02	09	06

Note: Prefix will be added to Course Code if applicable (T for theory Paper, P for Practical Paper and S for Term work)

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

Board of Study	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)	
	2418305	Python programming	30	70	20	30	20	30	200

Note: Prefix will be added to Course Code if applicable (T for theory Paper, P for Practical Paper and S for Term work)

Legend:

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

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

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

Note:

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

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: T2418305

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between Procedure Oriented P and Object Oriented Programming approach with example. *TSO 1b.* Use the concept of Lvalue and Rvalue *TSO 1c.* Write python program using various data types and operators	Unit 1: Fundamentals of Python Programming Syntax 1.1 Introduction to Python Character Set, Python Tokens, Variables, Lvalue and Rvalue Concepts, and the Use of Comments. 1.2Overview of Data Types: • Number Types: Integer, Floating Point, Complex • Boolean Type • Sequence Types: String, List, Tuple • None Type • Mapping Type: Dictionary • Distinction between Mutable and Immutable Data Types 1.3 Understanding Operators: • Arithmetic Operators • Relational Operators • Logical Operators • Assignment Operator • Augmented Assignment Operators • Expressions and Statements • Type Conversion and Input/Output Mechanisms • Precedence of Operators • Expression Evaluation	**CO-1**
TSO 2a. Write Python program using decision making statements *TSO 2b.* Write Python program using loop structure to solve iterative problems	**Unit-2.0 Conditional and Iterative statements** 2.1 Conditional statements: • simple if statement • if- else statemen • if-elif-else statement 2.2 Iterative statements: • while loop • for loop • range function • break and continue statements • nested loops	**CO-2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Perform various operations on string using string operators and methods *TSO 3b.* Perform various operations on List using list operators and methods *TSO 3c.* Perform various operations on tuples using tuples operators and methods *TSO 3d.* Perform various operations on set using set methods *TSO 3e.* Perform various operations on dictionary using dictionary methods	**Unit-3.0 String, List, Tuples, set and Dictionary** 3.1 String: • Indexing • string operations (concatenation, repetition, membership & slicing) • traversing a string using loops • built-in functions. 3.2 Lists: • Introduction • Indexing in list • list operations: concatenation, repetition, membership & slicing, traversing a list, built- in list functions, linear search on list of numbers and counting the frequency of elements in a list 3.3 Tuples: Creating, initializing, accessing elements, tuple assignment, performing operations on tuples, tuple methods and built-in functions, nested tuples 3.4 Set: Creating set, traversing, adding, removing data in set, performing set operations like join, Union intersection, difference 3.5 Dictionary: accessing items in a dictionary using keys, mutability of dictionary: adding a new item, modifying an existing item, built-in dictionary functions.	**CO-3**
TSO 4a. Create and use user defined functions to implement modular programming approach *TSO 4b.* Differentiate variable scope with example. *TSO 4c.* Import and use Python modules, libraries	**Unit-4.0 Python Functions, Modules and packages** 4.1 Functions: types of function (built- in functions, functions defined in module, user defined functions), creating user defined function, arguments and parameters, default parameters, positional parameters, Lambda functions, returning value, scope of a variable: global scope, local scope 4.2 Modules and Packages: Importing module using 'import' Regular Expressions, Exception Handling, PyPI Python Package Index, Pip Python package manager, Importing Libraries and Functions	**CO-4**
TSO 5a. Write simple Python programs using numpy *TSO 5b.* Use Numpy array in python program *TSO 5c.* Use Numpy to solve linear algebra problem.	**Unit-5.0 Numpy** 5.1 Introduction to NumPy 5.2 Installation of NumPy 5.3 NumPy Arrays: • Understanding the NumPy array	**CO-5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	• The fundamental data structure in NumPy. • Creation of arrays using different methods: np.array(), np.zeros(), np.ones(), etc. • Exploring array attributes like shape, size, and dimensions. 5.4 Array Indexing and Slicing: • Accessing elements and subarrays in NumPy arrays using indexing and slicing. • Demonstration of the difference between one-dimensional and multi-dimensional array indexing. 5.5 Array Operations: • Performing element-wise operations on NumPy arrays. • Exploring universal functions (ufuncs) for mathematical operations. 5.6 Linear Algebra with NumPy: • Introduction to linear algebra operations using NumPy. • Matrix multiplication, determinant, inverse, and solving linear equations. 5.7 File input and output with Numpy 5.8 Broadcasting in Numpy	
TSO 6a. Explain different types of Exceptions in python *TSO 6b.* Write Python programs for exception handling in Python *TSO 6c.* Differentiate different modes of file opening. *TSO 6d.* Perform read, Write, Append operations in files	**Unit 6: Exception and File Handling in Python** 6.1 Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes. 6.2 File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files, file access modes	**CO-6**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Write, execute and debug simple Python program using Integrated Development and Learning Environment (IDLE) *LSO 1.2.* Write and execute simple 'C' program using variables, arithmetic expressions.	1.	a) Download and Install IDLE. Write and execute Python program to- b) Calculate the Area of a Triangle where its three sides a, b, c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) c) Swap Two Variables d) Solve quadratic equation for real numbers.	**CO-1**
LSO 2.1. Write and execute python programs using conditional statements. *LSO 2.2.* Write and execute python programs using various types of Loop statements	2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	**CO-2**
LSO 3.1. Write and execute Python program to perform various operations on string using string operators and methods	3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	**CO-2, CO-3**
LSO 4.1. Write and execute Python program to perform various operations on List using List operators and methods	4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	**CO-2, CO-3**
LSO 5.1. Write and execute Python program to perform various operations on Tuple using Tuple operators and methods.	5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	**CO-2, CO-3**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 6.1. Write and execute Python program to perform various operations on sets using set methods.	6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	**CO-2, CO-3**
LSO 7.1. Write and execute Python program to perform various operations on Dictionary using Dictionary methods	7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	**CO-2, CO-3**
LSO 8.1. Write and execute Python program to create user defined functions and call them.	8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.	**CO-2, CO-4**
LSO 9.1. Write and execute Python program to define a numpy array. *LSO 9.2.* Develop and execute Python program Using various types of Numpy operation.	9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy h) Write a python program to Interchange two axes of an array	**CO-2, CO-5**
LSO 10.1. Develop and execute Python program to handle various type of exceptions. *LSO 10.2.* Develop and execute Python program to perform file operations.	10.	a) Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. Type Error ii. Name Error	**CO-6, CO-1, CO-2,**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		iii. Index Error iv. Key Error v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	

Note: in addition to above listed practical, students are suggested to practice all the examples covered by the teacher during theory sessions.

L) Suggested Term Work and Self Learning: S2418305 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. Crete a shop billing system
2. Create income tax calculation system.
3. Develop number guessing game (random integer will be selected by the system and the user has to guess that integer in the minimum number of guesses. Maximum 5 guess allowed.)
4. Assign numbers to alphabet a-z as (1-26). User will input a word. System will convert in to a number by adding all the individual alphabet of that word.
5. Design a basic calculator program that performs arithmetic operations like addition, subtraction, multiplication, and division based on user input.
6. Any other micro-projects suggested by subject faculty on similar line.

(Students may use file and sequence data types to develop above listed applications)

c. Other Activities:

1. Seminar Topics:

- Tkinter widgets in python
- Python date/time module and its applications
- wxPython and its applications

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	10%	10%	15%	16%	16%	10%	16%
CO-2	15%	15%	15%	16%	16%	15%	16%

CO-3	25%	25%	20%	18%	18%	25%	18%
CO-4	15%	15%	15%	16%	16%	15%	16%
CO-5	25%	25%	25%	18%	18%	25%	18%
CO-6	10%	10%	10%	16%	16%	10%	16%
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 Basics of Python Programming syntax	4	CO-1	7	3	2	2
Unit-2.0 Conditional and Iterative statements	6	CO-2	10	3	3	4
Unit-3.0 3.0 String, List, Tuples, set and Dictionary	12	CO-3	18	5	3	10
Unit-4.0 Python Functions, Modules and packages	7	CO-4	10	3	3	4
Unit-5.0 Numpy	12	CO-5	18	4	5	9
Unit-6.0 Exception and File Handling in Python	7	CO-6	7	2	2	3
Total	**48**	**-**	**70**	**20**	**18**	**32**

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.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	**CO-1**	40	50	10
2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval.	**CO-2**	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.				
3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	**CO-2, CO3**	40	50	10
4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	**CO-2, CO-3**	40	50	10
5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	**CO-2, CO-3**	40	50	10
6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	**CO-2, CO-3**	40	50	10
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	**CO-2, CO-3**	40	50	10
8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it.	**CO-2, CO-4**	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.				
9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy Write a python program to Interchange two axes of an array	**CO-2, CO-5**	40	50	10
h)	Using exception handling feature such as try…except, try finally-write minimum three programs to handle following types of exceptions. viii. TypeError ix. NameError x. IndexError xi. KeyError xii. ValueError xiii. IOError xiv. ZeroDivisionError	**CO-2, CO-6**	40	50	10
i)	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	**CO-1**	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, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	All
2.	Integrated Development and Learning Environment (IDLE)	S/w to be downloaded for python 3.11.3 or higher	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Computing and Problem-Solving using Python	E. Balagurusamy	McGraw Hill Education (India)Pvt. Ltd.1st Edition /2016
2.	Learning Python Programming	Jeffrey Elkner, Allan B.Downey, Chris Meyers	Samurai Media Limited. 2016
3.	Python Programming	Ashok Namdev Kamthane and Amit Ashok Kamthane	McGraw Hill Education (India) Pvt.Ltd.2020, 2nd Edition
4.	Programming in Python	Dr. Pooja Sharma	BPB Publications 2017

(b) Online Educational Resources:

1. https://docs.python.org/3/tutorial/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm

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A) Course Code : 2400207(T2400207)

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

C) Pre- requisite Course(s) :

D) Rationale :

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

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

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

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

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

CO-3 Analyze major constitutional amendments in the constitution.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

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

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

Legend:

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

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

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

Note:

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

I) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

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

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the meaning of preamble of the constitution. TSO 1b. List the salient features of constitution. TSO 1c. List the characteristics of constitution.	**Unit-1.0 Constitution and Preamble** 1.1 Meaning of the constitution of India. 1.2 Historical perspective of the Constitution of India.	**CO1**

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

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

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

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

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

b. Micro Projects:

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

c. Other Activities:

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

2. Visits:
    - Arrange Mock Parliament.
3. Design games and simulation on emergencies declared in last thirty years.

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

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

6. Cases: Suggestive cases for usage in teaching:

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

7. Self-learning topics:

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

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

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

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

O) Suggested 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.	The Constitution of India	P.M.Bakshi	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105
2.	Introduction to Indian Constitution	D.D.Basu	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3.	Introduction to Constitution of India	B. K. Sharma	PHI, New Delhi, 6thedition, 2011, ISBN:8120344197
4.	The Constitution of India	B.L. Fadia	Sahitya Bhawan,Agra, 2017, ISBN:8193413768
5.	The Constitutional Law of India	Durga Das Basu	LexisNexis Butterworths Wadhwa, Nagpur 978-81-8038-426-4

(b) Online Educational Resources:

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

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(c) Others:

******

A) Course Code : 2400408 (T2400408)

B) Course Title : Employability Skills Development (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Education may only be enough to qualify for a job, but employability skills are the major criteria to be considered for a job role. Employability skills are building blocks of any career and they equip one to carry out roles in the company to the best of their ability. Employers usually check these employability skills before hiring. These sets of job-readiness skills are behaviors that are necessary for every job and are essential attitudes that enable students to grow in their careers. Employers value employability skills because they regard these as indications of how their employees will get along with other team members and customers, and how efficiently they will be able to handle the job performance and career success. Employers like to hire a technical expert who also displays well-rounded employability skills.

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 Build resume and showcase portfolio for placement activity.

CO-2 Face interviews and participate effectively in Group Discussions.

CO-3 Apply engineering tools in work situations and societal processes.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	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				
		Employability Skills Development	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:

Board of Study	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)	
	2400408	Employability Skills Development	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: T2400408

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Perform SWOT analysis and reflect. *TSO 1b.* Develop skills in carrier planning & goal setting *TSO 1c.* Build a Resume using Internet formats. *TSO 1d.* Develop and Design portfolios. *TSO 1e.* Maintain good grooming attire. *TSO 1f.* Introduce oneself to others. *TSO 1g.* Develop a personal website.	**Unit-1. Goal Setting** 1.1 Career planning, SWOT 1.2 Resume using Internet formats. 1.3 Showcase portfolios. 1.4 Personal grooming. 1.5 Self-Introduction. 1.6 Website Development.	**CO1**
TSO 2a. Face interviews and E- Interviews confidently *TSO 2b.* Participate in group discussions. *TSO 2c.* Use Social media for personal enrichment &Netiquette *TSO 2d.* Manage self for higher growth. *TSO 2e.* Use body language for effective communication *TSO 2f.* Manage Emotions for personal growth	**Unit-2. Capacity Development** 2.1 Interview Skills 2.2 Group Discussion – Do's & don'ts, leadership, Teamwork, how to interrupt, synthesis, and analysis of topics. 2.3 Social Media for Personal Enrichment 2.4 Body language 2.5 Self-Management. 2.6 Emotional Intelligence	**CO2**
TSO 3a Develop & Maintain Social Contacts. TSO 3b Engage in Social Service projects. TSO-3c Collaborate for mutual advantage. TSO 3d Apply QC-Tools in work situations. *TSO 2g.* TSO 3e Practice Lean Manufacturing Techniques for Production and Operations	**Unit-3. Utilizing Potential** 3.1 Social Networking 3.2 Social Engagements, Volunteering 3.3 Collaboration& Team-work. 3.4 QC-Tools – Check sheets, Fishbone Diagram, Histogram, Pareto chart, Control-chart, Scatter Diagram, Stratification, 3.5 Lean Manufacturing, Kanban, Kaizen, Five S, Poka-yoke, Quality Circle	**CO3**

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

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

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

a. Assignments:

1 Build a resume for Placement Activity.

2 Prepare letters for job applications.

b. Micro Projects:

1. Prepare collage for personal grooming.
2. Develop a showcase portfolio.
3. Prepare a collage of different gestures and postures of Body Language.
4. Apply Five-S in a work situation.
5. Arrange Mock Interviews, appear, and video record. Reflect on your performance.
6. Organize Group discussions on current topics and video record. Reflect on your performance .

c. Other Activities:

1. Seminar Topics:
   - Emotional Intelligence.
   - 21st Century Skills.
   - Multitasking

2. Visits: Visit nearby Job Fairs, Career Guidance Fairs, etc.

3. Self-learning topics:

   - Use of social media.
   - Self-introduction.
   - Self-grooming.
   - QC Tools.
   - Lean Manufacturing,
   - Emotional Intelligence.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	30%	-	50%	-	-	-	-
CO-2	40%	-	25%	50%	-	-	-
CO-3	30%	-	25%	50%	100%	-	-
Total Marks	**25**	**-**	**10**	**10**	**5**	**-**	**-**
			25				

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

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

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

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications
1.	Group Discussion Tables and chairs	Round Table with seating arrangement for 15 person
2..	Mock Interviews infrastructure	2 parallel mock interview set up with recording facility.
3.	Ear phones	Compatible with mobile phones
4	Headphones	Compatible with laptop/desk top
5	Blue tooth	Compatible with mobile phones.
7.	CC TV Camera	Compatible to record presentations and addresses.
8.	Podium	For presentations on stage.
9.	Public address system	For public meetings.
10.	Full Glass Mirrors	For monitoring Body Language

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Employability Skills Skills for Employability	Dr. M. Sen Gupta	Innovation Publication Pvt Ltd, 2020 ISBN: 978-81-933819-1-5
2.	Employability Skills	Dr. Nishith Rajaram Dubey, Anupam Singh	Indra Publishing House, 2023 ISBN - 978-93-93577-68-9
3.	Organizational Behavior	A. K. Chitale, Rajendra Prasad Mohanty and Dr Nishith Dubey	PHI Learning Pvt Ltd ISBN 978-81-203-4696-3
4.	Managerial Skills	Dr Nishith Dubey & Prof Gitanjali Shrivastava	Shiva Prakashan, Indore, India,2010, ISBN 81-7677-100-7,
5.	Body Language	Allan Pease	Pease International PTY. Ltd Australia
6.	Production and Operations Management Goods & Services approach	Dr S.V Deshmukh, Dr A. K. Chitale and Dr Nishith Dubey	Archers & Elevators publishing house, Bangalore, ISBN 9789386501197
7.	Emotional Intelligence	Daniel Goleman	Word Press.Com, 9789382563792
8.	How to win friends and influence people	Dale Carnegie	Srishti Publishers & Distributors, Delhi, India

(b) Online Educational Resources:

1. 4-Year Plan For Career Success: https://eng.umd.edu/sites/clark.umd.edu/files/4%20Year%20Plan%20For%20Career%20Success_Categorized_1.pdf

2. CAREER DEVELOPMENT GUIDE https://www.engineersaustralia.org.au/sites/default/files/content-files/2016-12/career_development_guide_may_2014.pdf

3. Tips for successful career planning tips://www.aryacollege.in/tips-for-successful-career-planning-in-2021/

4. Career Planning – Complete Guidehttps://www.mygreatlearning.com/blog/what-is-career-planning/

5. Build Resume: https://www.themuse.com/advice/how-to-make-a-resume-examples

6. Build Resume https://resumegenius.com/blog/resume-help/how-to-write-a-resume

7. Body Language: https://ubiquity.acm.org/article.cfm?id=3447263

8.Group Discussions: https://brightspeaking.com/en/how-to-effectively-participate-in-a-group-discussion/

9.Carrier planning & goal setting: https://www.hays.com.au/career-advice/career-development/setting-career-goals

10. Carrier planning & goal setting: https://www.thebalancemoney.com/step-by-step-guide-to-setting-career-goals-2059883

11. Collaboration & teamwork: https://www.indeed.com/career-advice/career-development/teamwork-and-collaboration

12. Interview skills: https://www.youtube.com/watch?v=lKCTS9dY4h4

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:

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A) Course Code **: 2400009(T2400009)**

B) Course Title **:** Open Educational Resources (OER) (Non-Exam Course)
(FTS, CHE, CSE, EE, ME, ME (Auto), MIE, ELX, AIML, CRE, CACDDM, FPP, GT)

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

D) Rationale **:**

Open educational resources (OER) are openly-licensed, freely available educational materials that can be modified and redistributed by users. Learning about Open Educational Resources (OER), copyright, and Creative Commons licenses is a valuable endeavor for content creators, users, and anyone interested in sharing knowledge and creative works. Creative Commons licenses, offer a standardized way to grant permissions for the use and sharing of creative works. Learning about OER, copyright, and Creative Commons licenses is an ongoing process. As these fields evolve, it's important to stay informed and continue exploring new resources and practices.

After going through this course, students will at first place have reasonable idea to explore and use various OERs useful for their course of study and secondly, be motivated for fair use of resources available to them on various platform by understanding the restrictions and legal issues related to copyright and other licensing policies.

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

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

CO-1 Use Open Educational Resources (OER) after their evaluation
CO-2 Use copyright material appropriately.
CO-3 Implement suitable Creative Common License.

F) Suggested Course Articulation Matrix (CAM):

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

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

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

G) Teaching & Learning Scheme:

Board Of Study	Course code	Course Title	Scheme of Study (Hours/Week)				
			Classroom Instruction (CI)		Notional Hours (TW/ Activities+ SL)	Total Hours (CI+TW/ Activities)	Total Credits (C)
			L	T			
	2400009	Open Educational Resources	01	-	-	01	01

Legend:

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

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

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

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

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

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

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

H) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

I) Theory Session Outcomes (TSOs) and Units: T2400009

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the difference between OER and other free educational materials. *TSO 1b.* Describe the challenges and benefits of using OER in a class. *TSO 1c.* Apply various aspects of evaluating OER before use *TSO 1d.* Explain necessity to assess an OER's adaptability. *TSO 1e.* Use preliminary search for open educational resource. *TSO 1f.* Find OER using various resources.	**Unit-1.0 Open Educational Resources** 1.1 OER - definition 1.2 What is NOT OER. 1.3 Benefits of using OER – Benefits to Students - Access to Quality Education 1.4 OER - Benefits to Faculty - Use, Improve and Share, Network and collaborate with peers, Lower Cost, Improve access to information 1.5 Challenges of Using OER – Subject Availability, Format and Material type availability, Time and Support availability 1.6 Evaluating OER – a) Clarity, Comprehensibility, and Readability, b) Content and Technical Accuracy, c) Adaptability and Modularity, d) Appropriateness and Fit, e) Accessibility 1.7 Finding Open Content - OER Search Scenario Filter by Usage Rights in Google, Repositories and Search Tools, Subject-specific Repositories	**CO1**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 2a. Explain benefits of copyright protection for creator *TSO 2b.* Explain exceptions and limitations to copyright law *TSO 2c.* List rights granted to copyright holders. *TSO 2d.* Explain Exceptions and limitations to copyright law *TSO 2e.* Explain Fair use/fair dealing apply to copyright *TSO 2f.* Elaborate Public domain and how does it relate to copyright *TSO 2g.* Elaborate penalties for copyright infringement. *TSO 2h.* Explain copyright for digital content and the internet. *TSO 2i.* Explain use of copyrighted works in education *TSO 2j.* Explain the use of free licenses	**Unit-2.0 Copyright and Open Licensing** 2.1 Copyright and what it does protect, benefits of copyright protection for creators, duration of copyright protection last, rights granted to copyright holders. 2.2 Exceptions and limitations to copyright law, fair use/fair dealing apply to copyright 2.3 Public domain and its relation to copyright. 2.4 Penalties for copyright infringement 2.5 Apply copyright to digital content and the internet 2.6 Use of copyrighted works in education. 2.7 Open Licenses – GNU – Free Documentation license, Free Art License 2.8 Why Free Licenses – Retain, Reuse, Revise, Remix, Redistribute	**CO2**
TSO 3a. Describe the four different Creative Commons License components. *TSO 3b.* Explain the reason some CC-licensed content might not be considered OER. *TSO 3c.* Explain the Strength and weakness of four Open CC Licenses *TSO 3d.* Choose the right Creative Commons license for work. *TSO 3e.* Apply a Creative Commons license to existing work. *TSO 3f.* Use of Creative Commons licenses for commercial purposes. *TSO 3g.* Modify a work licensed under Creative Commons. *TSO 3h.* Revoke a Creative Commons license, combine works with different Creative Commons licenses *TSO 3i.* Differentiate between Attribution and Citation	**Unit-3.0 Creative Common Licenses** 3.1 Alternatives to copyright as Creative Commons licenses. 3.2 Four components of creative common Licenses – Attribution, Share- Alike, Non – commercial, No Derivatives 3.3 Choosing a Creative common licenses – Wiley's 5 Rs and Creative Common Licenses 3.4 Four Open CC Licenses and Their Strengths and Weaknesses – (a) CC BY (b) CC BY SA (c) CC BY NC (d) CC BY NC SA 3.5 Attribution Vs Citation - Creative Commons licensed work without giving attribution 3.6 Apply a CC License - choose the right Creative Commons license for work, apply a Creative Commons license to existing work, Creative Commons licenses be used for commercial purposes, modify a work licensed under Creative Commons, revoke a Creative Commons license, combine works with different Creative Commons licenses	**CO3**

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

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

a. Assignments:

Related to Open Educational Resources – CO1

i. OER help to reduce the cost of education for students. Justify?
ii. Explain why it is necessary to assess an OER's adaptability?
iii. Identify four search tools for finding open educational resources?
iv. Identify at least two search tools for finding openly licensed media?

Related to Copyright – CO2

i. Explain copyright and what does it protect
ii. Explain the rights granted to copyright holders

iii. Describe the exceptions and limitations to copyright law
iv. Elaborate the way fair use/fair dealing apply to copyright?
v. Describe the public domain and its relationship with copyright
vi. Elaborate the penalties for copyright infringement?
vii. Explain copyright apply to digital content and the internet
viii. Explain the way copyright law address the use of copyrighted works in education

Related to Creative Common Licenses – CO3

i. Explain various Creative Commons licenses
ii. Describe, how can you apply a Creative Commons license to your existing work?
iii. Explain the benefits of using Creative Commons licenses?
iv. Elaborate, how you can modify a work licensed under Creative Commons?
v. Are Creative Commons licenses valid worldwide?
vi. Elaborate how Creative Commons license can be revoked, once it has been applied to your work?
vii. Explain, how anyone use a Creative Commons licensed work without giving attribution?
viii. Explain the limitations/restrictions while using works with Creative Commons licenses?

b. Micro Projects:

1. Collect information on the impact of OER on cost savings and student engagement.
2. Search at least four OER related to topic of your Engineering Discipline over Internet. Evaluate the material based on the relevance, accuracy and usability.
3. Explore the different types of resources under creative Commons licenses (e.g., CC BY, CC BY-SA, CC BY-NC, etc.) and their specific permissions and restrictions.
4. Create a comparative analysis chart or infographic that visually represents the key characteristics of each license.
5. Select minimum 5 real-world examples from different domains (such as music, art, literature, or education) where creators have used Creative Commons licenses.

c. Other Activities:

1. Seminar Topics:
   - OER Quality Assurance
   - OER Repositories and Platforms
   - Creative Commons and Digital Media
   - Creative Commons in the Visual Arts
   - Examine the legal implications of using Creative Commons licenses, including the obligations and responsibilities of both creators and users and present it.

2. Self-learning topics:
   - Open Licensing and Copyright: Understanding the Legal Framework for OER
   - Creative Commons and the future of Copyright
   - Copyright and Open Access Publishing
   - Copyright and Software

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, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, 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: (If Any)

S. No.	Name of Equipment, Tools and Software	Broad Specifications
1.	Computers	Desktop computer with word processing and presentation facility
2.	Internet	Internet Connectivity

M) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The OER Starter Kit.	Abbey Elder - 2019	IA: Iowa State University Digital Press, available under a Creative Commons Attribution 4.0 International License. Retrieved from iastate.pressbooks.pub/oerstarterkit
2.	A Brief History of Open Educational Resources	Bliss, T J and Smith, M. - 2017	In: Jhangiani, R S and Biswas-Diener, R. (Eds.) Open: The Philosophy and Practices that are Revolutionizing Education and Science (pp. 9–27). London: Ubiquity Press. DOI: https://doi.org/10.5334/bbc.b.

Note: Above listed books are available in soft form and can be downloaded as given respective link

(b) Online Educational Resources:

1. OER for Empowering Teachers Instructional Material by P. Malliga is licensed under a Creative Commons Attribution 4.0 International License.
2. William & Flore Hewlett Foundation. (n.d.). OER defined. Retrieved from https://hewlett.org/strategy/open-educational-resources/
3. Free Software Foundation. (2008). GNU Free Documentation License. Retrieved from https://www.gnu.org/licenses/fdl.html
4. Copyleft Attitude. (2007). Free Art License 1.3. Retrieved from http://artlibre.org/licence/lal/en/
5. Free Software Foundation. (n.d.). What is copyleft? Retrieved from https://www.gnu.org/copyleft/copyleft.html

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

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