VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology

(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)

Department of Automation and Robotics

Department of Automation and Robotics Syllabus (NEP Scheme)

Sem-III
w.e.f. A.Y. 2025-26

VIVEKANAND EDUCATION SOCIETY'S
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Department of Automation and Robotics

Semester III
Scheme

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Department of Automation and Robotics

Semester III Scheme									
Course Type	**Course Code**	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
			Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Programme Core Course (PCC)	NARPC31	Sensors of Automation & Robotics	03	02	-	03	01	-	04
	NARPC32	Analog Electronics & Networks	03	02	-	03	01	-	04
	NARPC33	Digital Electronics	02	-	-	02	-	-	02
	NARPC34	Strength of Materials	02	-	-	02	-	-	02
Multidisciplinary Minor (MDM)	NARMM31	Course - 1	03	-	02	03	-	01	04
Humanities and Social Science in Management Courses (HSSM)	NAREM31	Financial Management	02	-	-	02	-	-	02
HSSM	NAREML32	Professional Communicatio n and Ethics-II	01	02	-	01	01	-	02
Total Credits									20

* *Tutorial for complete class*

Semester III Marks Scheme								
Course Type	**Course Code**	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
Programme Core Course (PCC)	NARPC31	Sensors of Automation & Robotics	60	20	20	25	25	150
	NARPC32	Analog Electronics & Networks	60	20	20	25	25	150
	NARPC33	Digital Electronics	60	20	20	-	-	100
	NARPC34	Strength of Materials	60	20	20	-	-	100
Multidisciplinary Minor (MDM)	NARMM31	Course - 1	60	20	20	25	-	125
HSSM	NAREM31	Financial Management	30	20	-	-	-	50
HSSM	NAREML32	Professional Communication and Ethics-II	-	-	-	25	25	50
Total Marks								**725**

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Department of Automation and Robotics

Semester III
Syllabus

Sensors of Automation & Robotics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC31	Sensors for Automation & Robotics (Theory)	03	-	-	03	-	-	03
NARPC31	Sensors for Automation and Robotics (Lab)	-	02	-	-	01	-	01

Sensors for Automation and Robotics (Theory)

Course Code	**Course Name**	**Teaching Scheme (Teaching Hours)**			**Credits Assigned**			
		Theory	**Practical**	**Tutorial**	**Theory**	**TW/PR**	**Tut**	**Total**
NARPC31	Sensors for Automation and Robotics (Theory)	03	-	-	03	-	-	**03**

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC31	Sensors for Automation and Robotics (Theory)	20	20	60	---	---	100

Course Prerequisite:	
Course Objectives:	
1	To explain the measurement systems, errors of measurement.
2	To provide an understanding of the operation of sensors and transducers.
3	To familiarize the student with the Identification, classification, construction, working principle and application of various transducers used in Industry for Temperature, Pressure & Vacuum, Level & Flow measurement
4	To provide an understanding of the construction, working principle and application of various transducers used for measurements of strain, displacement, force, torque and power, viscosity & density.
Course Outcomes: After successful completion of the course students will be able to:	
1	Explain the measurement systems, errors of measurement. List and compare various standards used for selection of transducers/sensors.
2	Describe the working principles of Temperature transducers and their applications.
3	Understand the working principles of Pressure & Vacuum Gauges and their applications.
4	Understand the working principles of Level transducers and their applications.
5	Identify types of Flow and understand the working of different transducers for Flow measurement.
6	Understand the working principle of various sensors used for strain, displacement, force, power, torque, viscosity & density measurement.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NARPC31	Sensors for Automation and Robotics (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC31	Sensors for Automation and Robotics (Lab)	---	---	---	25	25	50

Lab Prerequisite:	
Lab Objectives:	
1	To make students understand the identification, construction, working principles of various transducers used in Industry for Temperature measurement, Pressure and Vacuum measurement, Level measurement, Flow measurement and also other miscellaneous measurements.
2	To understand strength of material – using hardness test & tension test
Lab Outcomes: After successful completion of the course students will be able to:	
1	Validate the characteristics of various Temperature transducers.
2	Understand working of Pressure & Vacuum transducers and calibration of pressure gauges.
3	Understand the construction and operation of various Level transducers.
4	Understand the construction and operation of various Flow transducers.
5	Demonstrate the performance characteristics of miscellaneous transducers.
6	To understand strength of material – using hardness test & tension test.

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Sensors for Automation and Robotics (Theory)

Module	Chapter	Content	Hrs
1		**Introduction to Measurement Systems**	**04**
	1.1	Introduction, Block diagram, Functional elements of measurement system, Static and Dynamic characteristics of instruments (transducers). Errors in measurement, Remedies for Errors.	
	1.2	Definition of Sensor & Transducer, classification, selection criteria, Need for sensors and Transducers.	
2		**Transducers for Temperature Measurement**	**10**
	2.1	Temperature scales, classification of Temperature Sensors, Overview of Temperature Sensor Materials Gt	
	2.2	Resistance Temperature Detector (RTD): Principle, types, configurations, construction and working of RTD, 2 wire, 3 wire and 4 wire RTD Element, Lead wire compensation in RTD, self-heating effect, Specifications, advantages, disadvantages and applications of RTD	
	2.3	Thermocouple: Principle, thermo electric effect, See-beck effect, Peltier effect, Laws of thermocouple, types of thermocouples with characteristic curve, Thermocouple table, Sensitivity, constructional features of Thermocouples. Thermocouple specifications, cold junction compensation method, thermopile.	
	2.4	Thermistor, NTC & PTC Types, application,Characteristics.	
	2.5	Pyrometers: Principle, construction and working of radiation and optical Pyrometers and its applications Comparative study for Temperature sensors.	
	2.6	Miscellaneous: Construction and working of different types of Thermometers(Bimetallic, liquid, gas filled thermometers)	
3		**Transducers for Pressure & Vacuum Measurement**	**06**
	3.1	Pressure scales, units and relations, classification	

	3.2	**Primary pressure sensors** – elastic elements like bourdon tube, diaphragm, bellows, properties and selection of elastic materials, Calibration using Dead Weight Tester	
	3.3	**Electrical/secondary Pressure Transducers**: Capacitive, piezo-electric and its material, variable reluctance, LVDT, strain gauge	
	3.4	**High Pressure Measurement**: Bulk modulus cell, Bridgeman type, capsule and its applications.	
	3.5	**Differential pressure measurement**: construction & working of DP Cell, Manometers - U tube type and well type.	
	3.6	**Vacuum Measurement:** Units and relations, Mcleod gauge, Pirani gauge.	
4		**Transducers for Level Measurement**	**06**
	4.1	Need for level measurement, classification of Level Measurement Techniques.	
	4.2	Construction and working of displacer, float system, bubbler and DP CELL, ultrasonic, capacitive, microwave, radar, radioactive type, laser type transducer.	
	4.3	Level gauges, resistance, solid level detectors, fibre optic level detectors. Comparative study for level transducers.	
5		**Transducers for Flow Measurement**	
	5.1	Introduction to fluid flow: properties of fluid, types of fluid, Reynolds number, types of fluid flow, continuity equation. Bernoulli's equation, hydrostatic law, Pascal's law, Materials used for flow sensors, performance of materials, corrosion resistors, erosion, effect of vapor pressure.	**08**

	5.2	**Variable Head type**: Construction and working of Orifice, Venturi, nozzle, pitot tube, annubar, characteristics of Head type flow meters, **Variable area type**: Rotameter	
	5.3	**Velocity and Inertia based flowmeters**: Turbine, electromagnetic, ultrasonic, positive displacement, anemometers, mass flow meters, solid flow measurements.	
6		**Miscellaneous Measurement**	**05**
	6.1	**Transducers for Displacement:** Resistance type transducers: Potentiometer, piezo resistive effect. Capacitance type transducers with applications. **Pneumatic transducer**: Flapper – nozzle transducer.	
	6.2	**Torque**: Torsion bar. **Power:** Dynamometer, instantaneous power measurement, alternator power measurement. **Density measurement** – Displacement and float type densitometer, Radiation and Ultrasonic densitometers	
	6.3	**Sensors in Robotics:** Proximity Sensors : inductive, capacitive, optical, ultrasonic, hall effect and magnetic. Digital Transducers : Photoelectric sensors, limit switches, translation and rotary encoders. Optical Transducers, Inertial Measurement Units (IMU) - accelerometer, gyroscope	
		Total	**39**

Textbooks:	
1	B.C Nakra, K.K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw-Hill Education, 01-Oct-2003 - Electronic instruments - 632 page.
2	Patranabis D, Sensors and Transducers, Prentice Hall India Learning Private Limited; 2 edition (2003) - 344 pages.
3	A. K. Sawhney, Puneet Sawhney,A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co. Rai, 1996
4	Rangan, Mani, Sharma. Instrumentation systems and Devices, 2 nd Ed.,Tata McGraw Hill.
5	D.V.S. Murthi, —Instrumentation and Measurement Principles‖, PHI, New Delhi, Second ed. 2003.
Reference Books:	
1	Doeblin E.D., Measurement system, Tata McGraw Hill., 4th ed, 2003.
2	Bela G. Liptak, Instrument Engineers' Handbook, Fourth Edition, Volume One: Process Measurement and Analysis, June 27, 2003.
3	Neubert Hermann K. P., Instrument Transducer, 2nd ed., Oxford University Press, New Delhi, 2003.
4	Johnson Curtis D., Process Control Instrumentation Technology, 8th Ed., 2005
5	S.P. Sukhatme, Heat Transfer, 3rd edition, University Press.
6	B.E. Jones, Instrument Technology.
7	Chortle Keith R., Fundamentals of Test, Measurement Instrument Instrumentation, ISA Publication.
8	Alan S Morris, Measurement and Instrumentation Principles; 3rd Edition
9	Sawhney A.K., —Mechanical Measurement‖, Dhanpatrai And Co
10	Bansal R.K., —Fluid Mechanics and Hydraulic Machines‖, Laxmi publications.
11	David W. Spitzer, —Industrial Flow Measurement‖, ISA Publication

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Sensors for Automation and Robotics (Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Study and plot characteristics of resistance temperature detectors (RTD).
2*	Study and plot characteristics of Thermistors (PTC and NTC).
3*	Study and plot characteristics of different types of thermocouple.
4	Understand construction & working of Pressure Gauge.
5*	Study of U-Tube Manometer
6*	Study of Dead Weight Testers.
7	Level measurement using Ultrasonic Level transducer./DP Cell
8*	Level measurement using Capacitive type Level transducer.
9*	Study of Tubular Level Gauges.
10	Pressure drop measurement across pipe fittings
11*	Flow measurement using Orifice / Venturi / Nozzle
12*	Flow measurement using Rotameter.
13*	Flow measurement using Electromagnetic Flow Meter.
14	Flow measurement using Mass Flow Meter
15.	Strain Measurement using strain - gauge
16	Study of Linear variable differential transformer (LVDT)
17	Study of Flapper Nozzle System
18	To understand strength of material – using hardness test
19	To understand the strength of material –using tensile test

Note: Suggested List of Experiments is indicative. However, flexibility lies with individual

course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Suggested Factory visit to Sensors Manufacturing facility / unit.

Suggested Factories:

R K Dutt concern Thane

Gauges Bourdon India pvt Ltd. Kamothe

Tansa Equipments Thane

Eureka Industrial Equipments Pvt Ltd.. Pimpari

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

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Analog Electronics & Networks (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC32	Analog Electronics & Networks (Theory)	03	02	-	03	01	-	04

Analog Electronics & Networks

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC32	Analog Electronics & Networks (Theory)	03	-	---	03	-	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC32	Analog Electronics & Networks (Theory)	20	20	60	---	---	100

Course Objectives:	
1	To introduce the concept of circuit elements, circuit laws and analyze DC circuits using various theorems..
2	To analyze the transient & steady state response of AC circuits
3	To synthesize the circuits using different techniques
4	To familiarize the student with Diode and BJT circuits. To analyze the DC biasing circuits of BJT.
5	To familiarize the student with FET and MOSFET circuits. To analyze the DC biasing of FET circuits..
6	To design different types of voltage regulators and discuss the power amplifiers.
Course Outcomes: After successful completion of the course students will be able to:	
1	Analyze DC circuits using different theorems
2	Evaluate transient and steady state values of passive electrical networks
3	Synthesize the networks using canonical forms
4	Demonstrate the application of diodes and formulate the DC analysis of BJT.
5	Apply the basic construction and characteristics of FET and MOSFET and to formulate the DC analysis of FET.
6	Discuss the power amplifiers and design power supply using different IC

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NARPC32	Electronics (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme						
		Theory						
		Internal Assessment		End Sem Exam		Term Work	Practical & Oral	Total
		Mid-Term Test	Continuous Assessment					
NARPC32	Electronics (Lab)	---	---	---	---	**25**	**25**	**50**

Analog Electronics & Networks (Theory)

Module	Contents	Hrs.
1.	**Network Theorems:** Analysis of networks with dependent sources: mesh analysis, nodal analysis, super mesh and Supernode concept, superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.	**08**
2.	**Transient Analysis:** Initial Conditions in Elements, Solution of a First order and Second order differential equations, Transients and steady state response in R-L, R-C and RLC Circuits.	**06**
3.	**Fundamentals of Network Synthesis:** Causality and stability, Hurwitz polynomials, positive real functions, synthesis of one port networks with two kinds of elements. Properties and synthesis of L-C, R-C, R-L driving point impedances.	**06**
4.	**Diode applications:** Clipper and Clamper. **Bipolar Junction Transistor:** Device structure and physical operation, characteristics, BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuits, Stability Analysis.	**07**
5.	**Field effect Transistors:** Introduction to JFET, Types, Construction, Operation, Static Characteristics. FET as an amplifier and a switch. Biasing of FET amplifiers and its analysis (CS). **MOS Field effect Transistors:** Introduction to MOSFET, Device structure and physical operation, characteristics.	**06**
6.	**Power Amplifier:** Definition and amplifier types, Series fed class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Push Pull Amplifier, **Power supply design:** Using 78xx series, 79xx series and adjustable voltage IC regulators like 317.	**06**

Textbooks:	
1	Kuo Franklin F., "Network analysis and synthesis", Wiley International, 1962.
2	Van Valkenburg M.E., "Network analysis", Eastern Economy Edition, 1983.
3	Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI publishers, 2004
4	Thomas L. Floyd, Electronic Devices, Pearson 2015.
5	D. A. Neamen, Micro Electronic Circuit Analysis and Design, McGraw-Hill, New Delhi, 2010.
Reference Books:	
1	Hayt William, Kemmerly Jr.Jack E., "Engineering circuit Analysis", Tata McGraw Hill, 2002.
2	Edminister Joseph A., Nahvi Mohmood, "Electric Circuits", Tata McGraw Hill, 1999.
3	Shyammohan Sudhakar, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill.
4	J. Millman and C. C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems", Tata McGraw-Hill Publishing Company, 1988.
5	D. A. Bell, ―Electronic Devices and Circuits‖, OUP, India, 2010

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed.Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Electronics
(Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Design the Diode circuit as Clipper and Clamper.
2*	Verify the input -output characteristics of BJT in CE configuration.
3*	Implementation of a biasing circuit for BJT and estimate the parameters.
4*	Analyse the JFET circuit and validate its transfer characteristics.
5	Analyse the MOSFET circuit and validate its transfer characteristics.
6	Simulate the class A power amplifier and analyse with the help of simulation software.
7*	Design of fixed voltage regulator using fixed regulator IC.
8	Design of fixed voltage regulator using adjustable regulator IC.
9*	Implement all gates using universal gates and verify their truth table
10*	Design half & Full adder , half & Full subtractor using logic gates
11*	Design and implement binary to gray code converter and vice versa
12*	Implement Boolean expression using Multiplexer
13*	Realize Full adder using Demultiplexer
14	Implementation of various flip flops

15.	Design and implement ripple counter
16	Design 3 bit ring counter or 3 bit twisted ring counter

Note: Suggested List of Experiments is indicative. However, flexibility lie with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

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Digital Electronics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC33	Digital Electronics (Theory)	02	-	-	02	-	-	02

Digital Electronics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NARPC33	Digital Electronics	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC33	Digital Electronics (Theory)	20	20	60	---	---	100

Course Prerequisite:	
Course Objectives:	
1	To provide an understanding of the principles of digital electronics and use of number systems.
2	To provide knowledge about combinational logic circuits.
3	To describe working and design methods of sequential circuits.
4	To make students understand basic logic families and their applications.
5	To provide understanding of programmable logic devices, VHDL and FPGA programming
Course Outcomes: After successful completion of the course students will be able to:	
1	Represent numerical values in various number systems and perform number conversions between different number systems.
2	Analyze and design digital combinational circuits using logic gates .
3	Formulate and design Sequential logic circuits
4	Apply the concept of logic families and their application to design the digital system
5	Understand programmable logic devices and programming using VHDL and FPGA

Digital Electronics (Theory)

Module		Content	Hrs
1		**Binary number system & Boolean**	**07**
	1.1	Binary Arithmetic, Binary codes: Weighted, BCD,8421, Gray code, Excess 3 code, ASCII, Error detecting code.	
	1.2	**Reduction Methods:** Boolean laws, De-Morgan's Theorems, Minimization of Boolean Expressions, Sum of Products (SOP), Product of Sums(POS), Karnaugh map minimization, Don't care conditions.	
2		**Design of Combinational logic circuits:**	**06**
	2.1	Adders, Subtractors, Code converters, Parity checker, magnitude comparators	
	2.2	Multiplexer, Demultiplexer, Encoder and Decoder . Implementation of combinational logic circuits using Multiplexer and Demultiplexer.	
3		**Sequential logic circuits**	
	3.1	Flip flops- SR, D , MasterSlave JK and T-Realization of one flip flop using other flip flops,	**07**
	3.2	Asynchronous & Synchronous counters, Modulo n counters	
	3.3	Shift registers- different types - SISO, SIPO, PIPO, PISO, Ring counter and Twisted Ring counter	
4		**Logic Families:**	**03**
	4.1	Basics of digital integrated circuits, basic operational characteristics and parameters, TTL,	
	4.2	MOS devices, CMOS, comparison of logic families-PMOS, NMOS	
5		**Programmable logic devices:**	**03**

	5.1	Introduction to Complex Programmable Logic Device(CPLD), VHDL and Verilog – Implementation of AND, OR, Adders using VHDL and Verilog	
	5.2	Introduction to FPGA programming	
		Total	**26**

Textbooks:	
1	M. Morris Mano, "Digital Design", Prentice Hall of India, 2003.
2	John .M Yarbrough, "Digital Logic Applications and Design", Thomson-Vikas publishing house, 2002.
3	Barry B. Brey, "The Intel Microprocessors", Pearson/Prentice Hall, 2006.
4	R. P. Jain, "Modern Digital Electronics", Tata McGraw–Hill publishing company limited, 2003.
Reference Books:	
1	Charles H. Roth., "Fundamentals of Logic Design", Thomson Publication Company, 2003.
2	Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", Tata McGraw Hill Publishing Company Limited, 2003.
3	Thomas L. Floyd, "Digital Fundamentals", Pearson Education, 2003.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed.Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

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5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
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End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
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Strength of Materials

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NARPC34	Strength of Materials (Theory)	02	-	-	02	-	-	02

Strength of Materials

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC34	Strength of Materials (Theory)	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC34	Strength of Materials (Theory)	20	20	60	---	---	100

Course Prerequisite:	
Course Objectives:	
1	To study different types of stress, strain and deformation induced in the mechanical components due to external loads.
2	To study distribution of various stresses in the mechanical elements or bodies of finite dimensions that deform under loads.
3	To study properties and applications of a few Engineering materials used in building robots.
Course Outcomes: After successful completion of the course students will be able to:	
1	Estimate the moment of inertia of various sections and demonstrate fundamental knowledge on stresses and strains.
2	To study properties and applications of few Engineering materials used in Robots
3	Draw the SFD and BMD for different types of loads and support conditions.
4	Analyze bending stresses and deflections in beams

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Department of Automation and Robotics

Strength of Materials (Theory)

Module	Detailed Contents	Hrs.
1	**Moment of Inertia:** Concept and definition of moment of Inertia, Parallel Axis theorem (No derivation) Moment of Inertia of square, rectangle, circle, semi circle, triangle and I section about centroidal axis and any other axis parallel to centroidal axis. **Stresses and Strains:** Definition – Stress, Strain, Hooke's law, elastic limit, uniaxial and bi axial stresses, tensile & compressive stresses, shear stress. Poisson's ratio, Modulus of elasticity, Modulus of rigidity, Bulk Modulus, yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants (No derivations).	08
2	**Engineering Materials for Robots:** Stress-strain Diagram, Properties & important applications of metals (Steel, Aluminium, Copper, Brass, Bronze, Titanium), Ceramics, Composites, Plastics and elastomers.	04
3	**Shear Force and Bending Moment in Beams:** Shear force and bending moment diagrams for cantilever and simply supported beams subjected to point loads and uniformly distributed load.	07
4	**Bending Stresses and Deflection in Beams:** Theory of pure bending, Assumptions in the theory of bending, Flexural formula for straight beams, moment of resistance, section modulus for different sections, bending stress distribution diagram for cantilever and simply supported beams. Deflection of Cantilever and simply supported beams using Macaulay's Method for point load and uniformly distributed loadings.	07

	Reference Books:
1	Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016
2	Strength of Materials by Ryder, Macmillan
3	Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning, 6th Ed, 2009
4	Mechanics of Materials by Gere and Timoshenko, CBS 2nd Edition
5	Strength of Materials by Basavrajaiah and Mahadevappa, Khanna Publishers, New Delhi
6	Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
7	Mechanics of Materials by Beer, Johnston, Dewolf and Mazurek, TMH Pvt Ltd., New Delhi
8	Mechanics of Structures by S.B.Junnarkar, Charotar Publication
9	Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
10	Introduction to Solid Mechanics by Shames, PHI
11	Strength of Materials by Nag and Chandra, Wiley India
12	Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
13	Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition

Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed.Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

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Multidisciplinary Minor (MDM) Engineering Mathematics for ML

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARMM31	Engineering Mathematics for ML (Theory)	03	-	02	03	-	01	04

Engineering Mathematics for ML

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARMM31	Engineering Mathematics for ML	03	---	---	03	---	-	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARMM31	Engineering Mathematics for ML (Theory)	20	20	60	25	---	125

Course Prerequisite: Calculus, Complex numbers, trigonometry functions. basic linear algebra, matrices , and determinants,	
Course Objectives:	
1	To prepare students to apply the concept of eigenvalues and Eigenvector which will further be useful in applications like Google page rank algorithms, and principal component analysis (biometric system).
2	To build a strong foundation in mathematics, provide students with the mathematics fundamentals necessary to formulate, solve, and analyze complex engineering problems.
3	To prepare students to apply reasoning informed by contextual knowledge to engineering practice, and to work as part of teams on multi-disciplinary projects.
4	To prepare the students to use the information from the Laplace transform to convert a continuous signal from the time domain to the frequency domain.
5	To describe the ideas of Fourier and Laplace transforms and illustrate their application in the fields of PDE, Digital Signal Processing, Image Processing, Image Processing, Theory of wave equations, Differential equations, and many others.
6	To get familiar with the mathematical formulation of a real-world problem, become acquainted with the problem-solving techniques theoretically, tackle several parameters into account while dealing with the problem, and make aware the students of the applications of various forms of Linear Programming.
Course Outcomes: After successful completion of the course students will be able to:	
1	Compute Eigenvalues and Eigenvectors, and Apply the concept to analyze several characteristics of matrices, Quadratic forms, diagonalization, and Singular value decomposition.
2	Apply the Laplace transform and its properties to find the transform of a given function and evaluate some integrals of the real value function.
3	Students will be able to find the Z-transform of sequences using Properties and Inverse Z-transform using series expansion, and partial fraction.

4	Express a periodic function as a Fourier series in terms of sine and cosine functions.
5	Formulate a given simplified description of a suitable real-world problem as a linear programming model in general, standard, and canonical forms. Linear programming models can be solved by using the simplex method, Big M method, and Dual simplex method.
6	Solve Non-Linear Optimization problems using Lagrange's multiplier method and Karush Kuhn Tucker Method.

Engineering Mathematics for ML (Lab)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NARMM31	Engineering Mathematics for ML (Lab)	---	---	01	---	---	01	01

Course Code	Course Name	Examination Scheme					
		Theory					
		Internal Assessment		End Sem Exam	Term Work	Practical & Oral	Total
		Mid-Term Test	Continuous Assessment				
NARMM31	Engineering Mathematics for ML (Lab)	---	---	---	25	-	25

Engineering Mathematics for ML (Theory)

Module	Content	No. of Hrs
1	**Linear Algebra (Theory of Matrices):**	08
	1.1 Characteristic Equation, Eigenvalues and Eigenvectors, and properties (without proof) 1.2 Cayley-Hamilton Theorem, verification and reduction of higher degree polynomials. 1.3 Similarity of matrices, diagonalizable and non-diagonalizable matrices. 1.4 Quadratic forms over real field, reduction of Quadratic form to a diagonal canonical form, rank, index, signature of quadratic form. 1.5 Singular Value Decomposition.	
2	**Laplace Transform:**	07
	2.1 Definition and Condition of Existence of Laplace transform. 2.2.Laplace transform of standard functions like e^{at}, sin(at), cos(at), sinh(at), cosh(at,) and t^n, $n \geq 0$.	
	2.3 Properties of Laplace transform Linearity, First Shifting, Second Shifting, Change of Scale, Multiplication by t, Division by t, Laplace Transform of integral. 2.4 Evaluation of real improper integrals using Laplace transformation.	
3	**Z-Transform:**	05
	3.1 Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}, \{a^{\lvert k\rvert}\}, \{^{k+n}C_n a^k\}, \{c^k \sin(\alpha k + \beta\}, \{c^k \sinh\alpha k\}, \{c^k \cosh\alpha k\}.$ 3.2 Properties of Z-Transform: Change of Scale, Shifting Property,	

	Multiplication, and Division by k, Convolution theorem. 3.3 Inverse Z-Transform: Partial Fraction Method, Convolution Method. The inverse of Z-Transform by Series Expansion.	
4	**Fourier Series & Fourier Transform**	07
	4.1 Drichlet's Conditions, Definition of Fourier series 4.2 Fourier series of a periodic function with period 2π 4.3 Fourier series of even and odd functions. 4.4 Fourier integrals, Fourier cosine and sine integrals, Fourier transform, Fourier sine and Fourier cosine transforms and properties.	
5	**Linear Programming Problems:**	05
	5.1 Types of Solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables, Simplex method. 5.2 Artificial variables, Big-M method (Method of penalty)	
6	**Nonlinear Programming Problems:**	06
	6.1 NLPP with no constraint, one equality constraint (two or three variables) using the method of Lagrange's multipliers. 6.2 NLPP with two equality constraints. 6.3 NLPP with inequality constraints: Karush-Kuhn-Tucker (KKT) conditions.	
	Total	39

Textbooks:	
1	Linear Algebra and its Applications, D. C. Lay, Pearson
2	Textbook of Matrices, Shanti Narayan and P K Mittal, S. Chand Publication
3	David C. Lay, Linear Algebra and Its Applications, 5th Edition, Pearson.

4	Operations Research, Hira and Gupta, S. Chand Publication.
5	E.K.P. Chong, and S.H. Zak: An Introduction to Optimization, 3rd Edn, Wiley Interscience 2008
6	Higher Engineering Mathematics by Dr.Grewal,Khanna Publication.
Reference Books:	
1	Linear Algebra-Hoffman & Kunze(Indian editions)2002.
2	Linear Algebra –Anton 7 Torres (2012) 9th Indian Edition
3	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa Publication
4	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Limited.
5	D.G. Luenberger, Linear and Nonlinear Programming, 2nd Edn, Kluwer,2003.
Any other (Access to AI tools / Data driven insights (if applicable) or any other): Useful Link	
1	NPTEL :: Mathematics - NOC:Laplace Transform
2	NPTEL :: Mathematics - Linear Programming Problems

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed.Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks

4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Financial Management

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW /PR	Tut	Total
NAREM31	Financial Management (Theory)	02	-	-	02	-	-	02

Financial Management

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NAREM31	Financial Management (Theory)	02	-	-	02	-	-	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NAREM31	Financial Management (Theory)	20	-	30	---	---	50

Course Prerequisite:	
Course Objectives:	
1	To know about the Indian financial system, instruments and market.
2	To understand the relationship between risk, return and time value of Money.
3	To understand the financial statements and ratio analysis.
4	To understand personal taxation.
Course Outcomes: After successful completion of the course students will be able to:	
1	To explain the Indian financial system, instrument and market.
2	To determine risk, return and time value of Money with respect to financial decisions.
3	To decide investment decisions for projects with the help of financial ratios.
4	To determine components involved in taxation

Module	Chapter	Content	Hrs.
1		**Indian Financial System**	08
	1.1	Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds Debentures, Certificates of Deposit, Treasury Bills, Trade credit.	
	1.2	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	
	1.3	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions: Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2		**Financial Risk and Returns**	06
	2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio	
	2.2	Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	
	2.3	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3		**Corporate Finance**	06
	3.1	Overview of Financial Statements: Balance Sheet, Profit and Loss Account, and Cash Flow Statement.	
	3.2	Financial Ratio Analysis: Purpose of Financial Ratio Analysis. Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4		**Introduction to Taxation**	06

	4.1	Introduction and Objectives, Assessment Year, Previous Year, Person	
	4.2	Assessee, Assessment, Income	
	4.3	Gross Total Income, Total Income, Scheme of charging income tax	
		Total	**26**

Reference Books:	
1	Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2	Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3	Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4	Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks. Mid Term test is to be conducted when approx. 50% syllabus is completed.Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

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5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Professional Communication and Ethics-II

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NAREM32	Professional Communication and Ethics-II (Theory)	01	02	-	01	01	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NAREML32	Professional Communication and Ethics-II	-	-	-	25	25	50

Lab Prerequisite:	
Lab Objectives:	
1	To discern and develop an effective style of writing important technical/business documents.
2	To investigate possible resources and plan a successful job campaign.
3	To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4	To develop creative and impactful presentation skills.
5	To analyze personal traits, interests, values, aptitudes and skills.
6	To understand the importance of integrity and develop a personal code of Ethics.
Lab Outcomes: After successful completion of the course students will be able to:	
1	Plan and prepare effective business/ technical documents which will in turn provide a solid foundation for their future managerial roles.
2	Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3	Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4	Deliver persuasive and professional presentations.
5	Develop creative thinking and interpersonal skills required for effective professional communication.
6	Apply codes of ethical conduct, personal integrity and norms of organizational behavior.

Professional Communication and Ethics-II (Theory)

Module		Topics	Hours
1	**ADVANCED TECHNICAL WRITING : PROJECT/PROBLEM BASED LEARNING (PBL)**		6
	1.1	**Definition, Purpose & Types of Proposals** ● Solicited & Unsolicited Proposals ● Types (Short and Long proposals)	
	1.2	**Parts of a Proposal** ● Elements ● Scope and Limitations ● Conclusion	
	1.3	**Objectives of Report Writing** ● Information ● Decision Making ● Analysis ● Recommendations	
	1.4	**Parts of a Long Formal Report:** ● Prefatory Parts (Front Matter) ● Report Proper (Main Body) ● Appended Parts (Back Matter)	
	1.5	**Language and Style of Reports** ● Tense, Person & Voice of Reports ● Numbering Style of Chapters, Sections, Figures, Tables ● Referencing Styles in APA & MLA Format ● Proofreading through Plagiarism Checkers	

	1.6	**Technical Paper Writing:** ● Parts of a Technical Paper ● Language and Formatting ● Writing an abstract ● Referencing in IEEE Format	
	1.7	**Presenting data-figures, diagrams and labeling** ● Graphic Organizers for Summaries ● Radial Diagrams like Mind Maps ● Flow Charts ● Cyclic Diagrams ● Linear Diagrams like Timelines ● Pyramids ● Venn Diagrams	
2	**EMPLOYMENT SKILLS**		
	2.1	**Cover Letter & Resume** ● Parts and Content of a Cover Letter ● Difference between Bio-data, Resume & CV ● Essential Parts of a Resume ● Types of Resume (Chronological, Functional & Combination	**6**
	2.2	**Statement of Purpose** ● Importance of SOP ● Tips for Writing an Effective SOP	
	2.3	**Group Discussions** ● Purpose of a GD ● Parameters of Evaluating a GD ● Types of GDs (Normal, Case-based & Role Plays) ● GD Etiquettes	
	2.4	**Personal Interviews** ● Planning and Preparation ● Types of Questions ● Types of Interviews (Structured, Stress, Behavioral, Problem ● Solving & Case-based)	

		• Modes of Interviews: Face-to-face (One-to one and Panel) • Telephonic, Virtual	
3	**BUSINESS MEETINGS**		2
	3.1	• **Documentation** • Notice • Agenda • Minutes	
	3.2	• **Conducting Business Meetings:** • Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette	
4	**TECHNICAL/ BUSINESS PRESENTATIONS**		2
	4.1	• **Effective Presentation Strategies** • Defining Purpose • Analyzing Audience, Location and Event • Gathering, Selecting And Arranging Material • Structuring a Presentation • Making Effective Slides • Types of Presentations Aids • Closing a Presentation • Platform skills	

	4.2	**Group Presentations** ● Sharing Responsibility in a Team ● Building contents and visuals together ● Transition Phases	
	5.1	**Interpersonal Skills** ● Emotional Intelligence ● Leadership & Motivation ● Conflict Management & Negotiation ● Time Management ● Assertiveness ● Decision Making	5
6.	**CORPORATE ETHICS**		
	6.1	**6.1Intellectual Property Rights** ● Copyrights ● Trademarks ● Patents ● Industrial Designs	
	6.2	**Case Studies** ● Cases related to Business/ Corporate Ethics	
7	**PROFESSIONAL WRITING SKILLS**		**5**
	7.1	**Developing Professional Writing Skills** ● Effective introduction with emphasis on general statement, opposing statement and thesis statement ● Critical response to a text with special reference to purpose, evaluation of the content, theme and style of a text ● Organization of ideas, sentence construction and word choice, grammar and usage	

		• Explanation and support of ideas (special reference to writing paragraphs opening statement, body, closing statement, linkers)	
	7.2	**Creative Writing** • Narrative essays • Content writing • Blog	3
		Total	26

Reference Books:	
1	Lesiker and Petit (1997), "Report Writing for Business", McGraw-Hill Education10th edition
2	Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
3	Bove, C. L., & Thill, J. V. (2017). *Business communication today*, 14th Edition, NJ: Pearson.
4	Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational Behaviour*. Harlow, England: Pearson.
5	Fred Luthans. (2010). *Organizational Behavior* , McGraw Hill Education, 12th edition
6	B N Ghosh(2017), *Managing Soft Skills for Personality Development*, Tata McGraw Hill Education.
7	R. C. Sharma, Krishna Mohan, Virendra Singh Nirban (2020). *Business Correspondence and Report Writing* , 6th Edition, McGraw Hill
8	Julie-Ann Amos (2004). *Handling Tough Job Interviews* Jaico Publishing House
References: Web Links	
1	http://networketiquette.net/

2	https://public.wsu.edu/~brians/errors/
3	http://users3.ev1.net/~pamthompson/body_language.htm
4	http://www.albion.com/netiquette/corerules.html
5	http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/1535_questionanswer / pa ge15.shtml
6	http://www.colostate.edu/Depts/Speech/rccs/theory44.html
7	http://www.dailywritingtips.com

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3	Content beyond syllabus presentation	10 marks
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6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks

9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
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Department of Automation and Robotics

Semester IV
Scheme

Semester IV Scheme									
Course Type	**Course Code**	**Course Name**	**Teaching scheme (Contact Hours)**			**Credits Assigned**			
			Th	**Pr**	**Tut**	**Th**	**Pr**	**Tut**	**Total**
Programme Core Course (PCC)	NARPC41	Components of Automation & Robotics	03	02	-	03	01	-	04
	NARPC42	Signal Conditioning Circuit Design	03	02	-	03	01	-	04
	NARPC43	Embedded Systems	02	-	-	02	-	-	02
Multidisciplinary Minor (MDM)	NARMM41	Course - 2	03	-	-	03	-	-	03
Open Elective (OE) Other than a particular program	NOE4XX	OE-1	03	-	01	03	-	01	04
Entrepreneurship /Economics/ Management Courses	NAREM41	Introduction to Innovation and Entrepreneurship for Engineers	02	–	-	02	-	-	02
Comm. Engg. Project (CEP)/ Field Project (FP	NARFPL41	Field Project	-	04	-	-	02	-	02
Skill Courses (VSEC)	NARVEL41	Skill Lab - 1: Embedded Systems	01	02	-	01	01	-	02
Total Credits									23

Semester IV Marks Scheme								
Course Type	**Course Code**	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/ OR**	**Total**
Programme Core Course (PCC)	NARPC41	Components of Automation & Robotics	60	20	20	25	25	150
	NARPCL41*							
	NARPC42	Signal Conditioning Circuit Design	60	20	20	25	25	150
	NARPCL42*							
	NARPC43	Embedded Systems	60	20	20	--	–	100
Multidisciplinary Minor (MDM)	NARMM41	Course - 2	60	20	20	--	–	100
Open Elective (OE) Other than a particular program	NOE4XX	OE-1	60	20	20	--	–	100
Entrepreneurship/ Economics/ Management Courses	NAREM41	Introduction to Innovation and Entrepreneurship for Engineers	–	–	–	25	–	25
Comm. Engg. Project (CEP)/ Field Project (FP	NARFPL41*	Field Project	-	-	-	50	-	50
Skill Courses (VSEC)	NARVEL41*	Skill Lab - 1: Embedded Systems	-	-	-	25	25	50
Total Credits								725

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology

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Department of Automation and Robotics

Semester IV
Syllabus

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Automation and Robotics

Course Name- Components of Automation & Robotics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC41	Components of Automation & Robotics (Theory)	03	---	---	03	---	---	03
NARPC41	Components of Automation & Robotics (Lab)	---	02	---	---	01	---	01

Components of Automation & Robotics (Theory)

Course Code	**Course Name**	**Teaching Scheme (Teaching Hours)**			**Credits Assigned**			
		Theory	**Practical**	**Tutorial**	**Theory**	**TW/PR**	**Tut**	**Total**
NARPC41	Components of Automation & Robotics (Theory)	03	---	---	03	-	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC41	Components of Automation & Robotics (Theory)	20	20	60	– --	–	100

Course Prerequisite:	
Course Objectives:	
1	To impart knowledge of different control system components like Hydraulic, Pneumatic, Electrical & Electronics and their comparison.
2	To make the students learn different types of Transmitters.
3	To make the students understand the concept of control valve, different types, their working & selection criteria.
4	To make the students to learn various Auxiliary process control components and its applications
5	To give the students an overview of Industrial Control components & their Need in Automation and Robotics.
Course Outcomes: After successful completion of the course students will be able to:	
1	Explain and select various pneumatic system components and circuits.
2	Select and compare various control systems like Hydraulic, pneumatic and electric.
3	Apply knowledge to classify, select and use various transmitters.
4	Classify and select various control valves and their accessories.
5	Describe and select industrial components and study their usage.
6	Demonstrate major components of industrial robots.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NARPC41	Components of Automation & Robotics (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC41	Components of Automation & Robotics (Lab)	-	-	-	25	25	50

Lab Prerequisite:	
Lab Objectives:	
1	To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement
2	To study electro-chemical sensors and transducers used for density and viscosity measurement
3	To impart knowledge of different control system components like Hydraulic, Pneumatic and Electrical and their comparison.
4	To make the students learn different process components and auxiliary process control components.
Lab Outcomes: After successful completion of the course students will be able to:	
1	Study, select and implement various pneumatic system components and circuits.

2	Study, select and implement various hydraulic/electro-pneumatic system components and circuits.
3	Apply knowledge to classify, select and use various Transmitters and I/P and P/I converters.
4	Apply knowledge to classify, select and use various types of control valves and its characteristics.
5	Describe the importance of panel switches, parameter switches and control relays, also study their industrial usage
6	Apply knowledge to implement the components of Industrial Robots.

Components of Automation & Robotics

Module	Contents	Hrs
1	**Pneumatic Components** Introduction, significance of Automation components. Pneumatic components: ISA symbols, Instrument Air and Plant Air. Air compressor system and its accessories,Pressure regulation methods. Directional control valves and special types of pneumatic valve such as Pilot-operated valves, non-return valves, Flow control valves, Sequence valves, and Time delay valve, Linear actuators- Single- acting, Double-acting, and special type of double acting cylinder, process Control Pneumatics: Pneumatic logic gates, Pneumatic Circuits-Standard Symbols used for developing pneumatic circuits, Sequence diagram.	08
2	**Hydraulic Components:** Hydraulic components: Hydraulic pumps (centrifugal, gear, lobe), Pressure regulation method, Loading valves, Hydraulic valves, Selection and comparison of pneumatic, hydraulic and electric systems	04
3	**Field Transmitters:** Need for transmitters, Standardization of signals, concept of live zero and dead zero, classification of transmitters: Conventional and SMART. Conventional Electronic type transmitters - temperature; Pressure (gauge); differential pressure; level (capacitive type); flow transmitter (magnetic);	06

	SMART /Intelligent transmitter; Block schematic and working of transmitter, specifications and features, applications of transmitters.	
4	**Final control Elements & accessories** **Control Valves:** Need and specifications of Control Valve; Control valve terminology; Control valve constructional details; Air to Open (AO), Air to Close (AC); MOC (Material of construction); classification of control valve; applications, advantages, disadvantage of Globe, Ball, Needle, Butterfly, Diaphragm, Pinch, Gate, Solenoid; Flow characteristics (Inherent and Installed): Valve positioners: necessity, types-motion balance and force balance, Effect on Performance of control valve; Feeders & dampers. **Actuators:** Types of actuators, Specifications, selection guidelines. **Converters:** Need for Converters and types, working of Pneumatic to Electrical and Electrical to Pneumatic converters. **VFD:** introduction and Need, working of AC & DC drives. **Safety valves:** working of safety valve, relief valve and their application. **Accessories:** Volume boosters, Air relays, solenoid valve	10
5	**Auxiliary control components** **Panel Switches**: Overview of panel switches and its applications. **Industrial switches:** Temperature, Flow, Level and, Pressure Switch, Vibration switch. **Control Relays:** Construction, working, specifications, and applications of Electro- mechanical relay, Solid state relays. Interposing relays and Overload relays. **Contactors/starters:** Construction, working, specifications and applications of starters and contactors. Comparison between relays and starters /contactors. Alarm annunciators and its sequences	06
6	**Components of Industrial Robot** Manipulators, End Effectors, Feedback devices, Controllers, and Locomotive devices, Limit switches, proximity switches.	05

	Overview of DC motor, stepper motor and servo motor.	
	Total	**39**

Textbooks:	
1	Andrew Parr, Hydraulic & pneumatics; A Technicians & Engineers Guide, Second Edition
2	Control Valve Handbook – Fourth Edition, Fisher.
3	Pneumatics workbook Basic Level - FESTO
4	C. L. Albert and D.A. Coggan, "Fundamentals of Industrial Control", ISA, 1992.
5	Bela G. Liptak, "Instrument Engineer's HandBook – Process Control", Chilton Company, 3rd Edition, 1995.
6	Andrew Williams, "Applied instrumentation in the process industries", 2 nd Edition, Vol. 1 & 3, Gulf publishing company.
7	Guy Borden, Paul G Friedman, style Editor Control Valves- ISA
8	Process Instruments & Control Handbook, Douglas. M. Considine, McGraw-Hill
Note:	
1)	Minimum of Eight experiments can be conducted during the semester for term work and practical examination
2)	Factory visit is advised to understand the working of the control system components.
3)	Assignments based on syllabus which will help students to understand the Topic can be given during the semester as a support to Evaluate Term work.

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Components of Automation & Robotics (Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.
Star (*) marked experiments are compulsory.

Sr. No.	Name of the Experiment
1*	Study of various pneumatic control system components
2*	Development of pneumatic circuits.
3*	Study of various electro-pneumatic control system components.
4	Study of various hydraulic control system components
5*	Study operation and working of flow transmitter
6*	Study operation and working of temperature transmitter
7	Study operation and working of level transmitter
8*	Study operation of current to pneumatic converter.
9*	Study various parts of the control valve.
10	Study different types and operation of control valves.
11*	Study different plug characteristics of single seated globe control valves.
12*	Study different types of control valve actuators.
13*	Study different types and operation of valve positioners.
14	Study of panel switches.
15.	Study of pressure/temperature/level/flow switches and control relays.
16	Study of Robotic arms.
17	Study of speed control of Stepper/ Servo/ DC motor.

Note: Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Suggested Factory visit to control components Manufacturing facility /

unit. Suggested Factories:

R K Instruments Thane

Fluidteq pneumatics Ambernath

Rotex Dombivli

pneucon valves Thane

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Signal Conditioning Circuit Design

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC42	Signal Conditioning Circuit Design (Theory)	03	---	---	03	---	---	03
NARPC42	Signal Conditioning Circuit Design (Lab)	---	02	---	---	01	---	01

Signal Conditioning Circuit Design (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC42	Signal Conditioning Circuit Design (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC42	Signal Conditioning Circuit Design (Lab)	20	20	60	---	---	100

Course Prerequisite:	
Course Objectives:	
1	To introduce the students the basic properties of Op-amp, analysis and design of electronic circuits using Op-amp
2	To give the knowledge about the various components of analog signal conditioning
3	To impart knowledge of design considerations of analog signal conditioning of components.
4	To give the student's knowledge about various components digital signal conditioning.
5	To make the students capable to apply knowledge to design various transducer signal conditioning circuits
Course Outcomes: After successful completion of the course students will be able to:	
1	Describe op-amp parameters and types and derivation of operational amplifiers
2	Design the various operation amplifier circuits for linear applications.
3	Formulate and design non-linear applications of op-amp.
4	Design of analog signal conditioning circuits
5	Design of Digital signal conditioning circuits
6	Apply signal conditioning concepts to design various transducer/ sensors signal conditioning circuits

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Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NARPC42	Signal Conditioning Circuit Design (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC42	Signal Conditioning Circuit Design (Lab)	---	---	---	25	25	50

Lab Prerequisite:	
Lab Objectives:	
1	To introduce the students the basic properties of Op-amp, analysis and design of electronic circuits using Op-amp.
2	To give the knowledge about the various components analog and digital signal conditioning
3	To make the students capable to apply knowledge to design various transducer signal conditioning circuits
Lab Outcomes: After successful completion of the course students will be able to:	
1	Evaluate op-amp parameters and design of basic operational amplifier circuits.
2	Design and implement the various operation amplifier circuits for linear applications.
3	Design and implement the various non-linear applications using op-amp.
4	Apply principles of Analog signal conditioning for op-amp based circuit design.
5	Apply principles of Digital signal conditioning for op-amp based circuit design.

6	Design and develop signal conditioning circuits for different transducers.

Signal Conditioning Circuit Design (Theory)

Module	Contents	Hrs
1	**Fundamentals of Operational Amplifier** Block diagram of Operational amplifier, Ideal Op Amp, characteristics of op-amp, op-amp parameters, Operational amplifier – open loop and closed loop configurations, Inverting and non-inverting amplifier.	**04**
	Linear Applications of Operational Amplifier Adder, subtracter, difference amplifier, Integrator, and practical integrator, Differentiator and practical differentiator, Current to Voltage converter, voltage to current converter (grounded and floating load), Instrumentation amplifier with three Op-amps, and application of Op-Amp in Sensor Measurement System.	**08**
2	**Nonlinear Applications of Operational Amplifier** Comparator and its characteristics, Zero Crossing Detector (ZCD), Schmitt trigger, window detector, Sample and Hold Circuit, Peak to Peak Detector, Precision half wave and full wave rectifiers, Sine wave oscillators using op-amp.: Barkhausen criteria, Wein bridge oscillator, RC phase shift oscillator. Waveform Generators: Square wave generator and triangular wave generator, Design of Astable and Monostable Multi-vibrators using IC 555, Phase Locked Loops (PLL)	**08**
	Analog Signal Conditioning Standard analog signals, Signal Level and bias changes, Linearization, conversion, filtering and impedance matching, concept of loading. Voltage divider, Wheatstone bridge circuits, Active filter. Guidelines for analog signal conditioning design and design-based problems.	**04**
3	**Digital Signal Conditioning** Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency; Interfacing of Sensors / Actuators to Data Acquisition system; Converters – 4 bit Successive Approximation type ADC, Flash ADC; 4 bit R- 2R type DAC; Current and Voltage Amplifier, V to F and F to V converters, Data logger circuit.	**09**
	Transducer Signal Conditioning	

	Signal Conditioning of Temperature, Pressure, Optical, Displacement and Piezoelectric transducers.	**06**
	Total	

Textbooks:	
1	Ramakant Gaikwad, *"Op-amp & Linear ICs"*, PHI Pearson Education, 2003.
2	C. D. Johnson, *"Process Control Instrumentation Technology"*, 2016.
3	D. E. Pippenger and E. J. Tobanen, *"Linear and Interface Circuits Applications"*, McGraw Hill, 1988.
4	William D. Stanley, ―Operational Amplifiers with Linear Integrated Circuits‖, Pearson.
Reference Books:	
1	Roy Choudhary, *"Linear Integrated Circuits"*, Wiley Eastern, 1991.
2	Coughlin & Driscoll, *"Op-amp and Linear ICs"* 6th Edition, PHI 2002.
3	Sergio Franco, *"Design with op-amp analog ICs"* McGraw Hill, 1988.

Internal Assessment:

4) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
5) Mid Term test is to be conducted when approx. 50% syllabus is completed.
6) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks

6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Signal Conditioning Circuit Design (Lab)

Suggested Experiments: Students are required to complete at least 10 experiments.	
Star (*) marked experiments are compulsory.	
Sr. No.	**Name of the Experiment**
1*	Demonstrate use of Op-Amp as inverting and non-inverting amplifier
2*	Determination of op-amp parameters - CMRR, Slew Rate, Offset Voltage & bias current
3*	To implement Adder and Subtracter using Op-amp
4	To design an Instrumentation Amplifier using 3 Op-amps.
5*	To design and demonstrate I to V and V to I converter circuit
6*	To design and demonstrate integrator and differentiator using Op-amp.
7	To design and implement Astable Multivibrator using IC 555
8*	To design and implement Monostable Multivibrator using IC 555
9*	To Implement Precision rectifiers using Op-amp.
10	To design oscillator circuits using op-amp.
11*	To design and demonstrate second order LPF for a given frequency range.
12*	To design and demonstrate second order HPF for a given frequency range.
13*	To design and demonstrate Analog to Digital converter circuit.
14	To design and demonstrate Digital to Analog converter circuit.

15.	To design a V-to-F or F-to-V converter circuit using an op-amp.
16	To design a signal conditioning circuit to convert sensor output to 0-5V.
17	Design signal conditioning circuit to convert sensor output to 4-20mA
18	Design and demonstrate signal conditioning circuit for load measuring system using strain gauge.
19	Design signal conditioning circuit for Temperature Transducers like RTD/Thermocouple/Thermistor.
20	Design signal conditioning circuit for optical transducers like LDR /photo-diode.

Note: Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

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Course Name -Embedded Systems

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC43	Embedded Systems (Theory)	02	---	---	02	---	---	02

Embedded Systems (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARPC43	Embedded Systems (Theory)	02	---	---	02	---	---	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARPC43	Embedded Systems (Theory)	20	20	60	---	---	100

Course Objectives:	
1	To give an overview of embedded systems and make students aware of design challenges and technology.
2	To give knowledge of Software and Hardware processor design
3	To impart knowledge of fundamentals of the MCS-51 microcontroller family and working of the system
4	To impart knowledge of embedded systems communication and sub systems
Course Outcomes: After successful completion of the course students will be able to:	
1	Explain the architecture of embedded systems.
2	Understand General Purpose Processor Basic Architecture
3	Design using 8051 architecture and peripherals
4	Understand various subsystems and communication protocols used in embedded systems

Embedded Systems (Theory)

Module	Contents	Hrs
1	Embedded System Overview, Design Challenges, Processor Technology,IC Technology, Design Technology Custom Single Processor Design and Optimisation	6
2	General Purpose Processor Basic Architecture, Operation, Programmer's View , Memory Models, RISC vs CISC 8051 Basic Architecture,I, Programmers Model, Instruction overview	7
3	8051 Architecture I/O, Timers, Counters, UART, PWM, Watchdog	7
4	Embedded Communication Protocols I2C, SPI, Single Wire Embedded SubSystems DMA, Different types of Memory and their uses	6
	Total	

Textbooks:	
1	Embedded System Design: A Unified Hardware/Software Introduction Frank Vahid and Tony Givargis John Wiley & Sons; ISBN: 0471386782. Copyright (c) 2002.
2	Mazidi M.A., The8051 Microcontroller & Embedded systems, Pearson Education Second edition.2006
3	Kenneth Ayala, The8051 Microcontroller, Thomson Delmar Learning, Third Edition.2005

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks

2)Mid Term test is to be conducted when approx. 50% syllabus is completed.

3)Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
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3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Statistics & Probability

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Department of Automation and Robotics

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARMM41	Statistics & Probability (Theory)	03	---	---	03	---	---	03

Statistics & Probability**(Theory)**

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARMM41	Statistics & Probability (Theory)	03	---	---	03	---	---	03

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARMM41	Statistics & Probability (Theory)	20	20	60	---	---	100

Course Objectives:	
1	To provide a robust foundation for statistical and probabilistic analysis, which are predominantly utilized in various engineering applications.
2	To equip the students with a working knowledge of probability, statistics, and modeling in the presence of uncertainties.
3	To help the students develop an interest in random phenomena and to introduce both theoretical issues and applications that may be useful in practical life.

4	To build an intuitive understanding of probability and statistics and relate it to Artificial Intelligence, Machine Learning, and Data Science.
5	to comprehend the significance of sample design and analysis methods for research in numerous fields.
6	To understand the concept of hypothesis and significance tests.
Course Outcomes: After successful completion of the course students will be able to:	
1	build the foundations for probability and understand the concepts of the Bayes theorem and bootstrapping and their uses.
2	Understand random variables and the theory of discrete and continuous probability distributions.
3	Understand the relation between distributions and Compute probability using the probability distribution of discrete and continuous Random variables, Binomial, Poisson, Normal distribution, etc.
4	Apply the concept of Correlation and Regression, fitting of curves to the given data sets.
5	Develop the fundamental concepts of testing hypotheses, formulating statistical hypotheses in real-life situations, and applying testing hypotheses associated with small samples using t-distribution.
6	Understand the basic theory of Chi-square tests and an F-test.

Statistics & Probability (Theory)

Module	Contents	Hrs
1	**Probability Theory**	04
	1.1 Definition and basics of Random experiment, Sample space, Events, Mutually exclusive and exhaustive events, Probability of an event, Addition rule.	

	1.2 Conditional probability, Multiplication rule, Independent events, Total probability theorem, Bayes' theorem and its applications. **Self-Learning:** Applications of ML	
2	**Random Variables and their distributions**	09
	2.1 Discrete random variable, probability mass function, continuous random variable, probability density function, cumulative distribution function. 2.2 Joint probability distributions of two random variables: discrete and continuous, marginal and conditional distribution, and independence of random variables. 2.3 Probability distribution of functions of one and two random variables. 2.4 Expectation, Variance, Covariance, Raw and Central Moments, Moment generating function. 2.5 Skewness and Kurtosis. **Self-Learning:** Applications of ML	
3	**Some Special Probability Distributions**	09
	3.1 Binomial distribution, Poisson distribution. 3.2 Uniform distribution, 3.3 Central limit theorem, Normal distribution. **Self-Learning:** Applications of ML	
4	**Regression Analysis**	05
	4.1 Model and parameter estimation, Correlations, Karl Pearson's coefficient of correlation, Spearman's Rank correlation coefficient (repeated and non-repeated ranks). 4.2 Fitting of first and second-degree curves. 4.3 Lines of regression, Regression coefficients.	
5	**Sampling Theory and Testing of Hypotheses-I**	08
	5.1 Parameter and statistics, Sampling Distribution of Statistics, Standard error, Null and alternative hypotheses, the critical and acceptance regions, Level of Significance, One-tailed, and two-tailed test, Procedure for testing of Hypothesis.	

	5.2 Test of significance of proportion, mean, and difference between the means of two samples for Large samples. 5.3 Student's t-distribution, Test of significance of mean and the difference between the means of two samples for Small samples.	
6	**Sampling Theory and Testing of Hypotheses-II**	04
	6.1 Chi-square test for goodness of fit and independence of attributes, Yate's Correction. 6.2 F- test for ratio of variances.	
	Total	39

Textbooks:	
1	Gupta and Kapoor, Fundamental of Mathematical Statistics, S Chand
2	Probability, Statistics, and Random Processes, T. Veerarajan, McGraw-Hill Education.
3	Palaniammal S, Probability and Random Processes, Prentice Hall India Learning Private Limited
4	Research Methodology Methods and Techniques, CR Kothari. Gaurav Garg.New Age International Publication. https://biologywala.com/download-research-methodology-book-pdf-by-kothari/
5	Devore, J. L.: Probability & Statistics for Engineering and the Sciences, 8th edition, Cengage Learning, 2012.
Reference Books:	
1	Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2	Milton, J. S. and Arnold J. C.: Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th edition, Tata McGraw-Hill, 2007.
3	Meyer, P. L.: Introductory Probability and Statistical Applications, 2nd edition, Addison-Wesley, 1970.
4	Probability and Statistics in Engineering by W.W. Hines, D.C. Montgomery, D.M. Gpldsman & C.M.Borror

5	Ross, S. M.: Introduction to Probability Models, 11th edition, Academic Press, 2014.
6	Johnson, R. A., Miller: Freund's Probability and Statistics for Engineers, 8th edition, PHI, 2010.
7	Draper ,N.R., and Smith, H .(2003) , Applied Regression Analysis,New York :Wiley
Access to software and virtual labs:	
1	Introduction to Probability and Statistics, IITMadras - https://onlinecourses.nptel.ac.in/noc21_ma01/preview
2	Probability and statistics, IIT Kharagpur - https://nptel.ac.in/courses/111105090

Internal Assessment:

7) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
8) Mid Term test is to be conducted when approx. 50% syllabus is completed.
9) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Design Thinking

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE401	Design Thinking (Theory)	03	---	01	03	---	01	04

Design Thinking
(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE401	Design Thinking (Theory)	03	--	01	03	---	01	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NOE401	Design Thinking (Theory)	20	20	60	---	---	100

Course Objectives:	
1	To cultivate a thorough grasp of Design Thinking's definition, principles, and practical applications.
2	To achieve proficiency in Design Thinking methodologies and processes, encompassing the 5-stage approach and various implementation strategies.
3	To learn diverse methods and tools during the Empathize and Design phases of product development within the framework of Design Thinking.
4	To learn to apply design thinking tools and methods in ideation stage
5	To comprehend different prototype methods and learn the importance of testing.
6	To apply Design Thinking principles through case studies and real-world scenarios, fostering practical understanding and proficiency in problem-solving and innovation.
Course Outcomes: After successful completion of the course students will be able to:	
1	To identify opportunities, empathize with users, generate innovative solutions, and prepare effective design briefs.
2	Students will learn to use design thinking resources, principles, and the 5-stage process to solve case studies effectively.
3	Students will learn to apply various methods and tools for the empathize and design phases, finalize problem statements, and use design thinking for product development.
4	Students will learn to apply various methods and tools for the empathize and design phases, finalize problem statements, and use design thinking for product development.
5	Students will learn to create and test various prototypes, collect feedback, and iterate to improve ideas.
6	Gain insights into the impact of cross-disciplinary collaborations, ethical considerations, cultural sensitivity, global perspectives, and technology integration on real-world business and societal challenges.

Design Thinking

Module	Contents	Hrs
1	**Introduction to Design Thinking**	05
	Design Thinking Background: Definition, Importance, Origin, Design Vs Design Thinking, Problem Solving and Need, Principles of Design Thinking, Business Uses, Variety within the Design Thinking Discipline **Design Thinking Approach:** Empathy, Ethnography, Divergent Thinking, Visual Thinking, Assumption Testing and Prototyping *Activities for Tutorials* *Identify an Opportunity and Scope of the Project Explore the possibilities and prepare a design brief*	
2	Design thinking process and methodology.	08
	Design Thinking Resources: Organization , People, Place, Material **Principles of Design Thinking Design Thinking Processes** **Design Thinking Methodology** The 5 Stages of the Design Thinking Process- Empathize,Define (the problem), Ideate, Prototype, and Test. *Activities for Tutorials* *Identify the design thinking process and methodology which will be useful for your case study and also identify the important applicable principles.*	
3	Empathize and Design	07

	Methods and Tools for Empathize and Design phases Ask 5 Why (5W+H Questions), Stakeholder and Empathy Map Peer Observation, Trend Analysis, Data Gathering methods, Observation, Focus Graph, Interview, Q&A, Design Thinking Application, Design Thinking Applied to product development. *Activities for Tutorials* *Apply the methods of empathizing and Define Phases Finalize the problem statement.*	

4	Design Thinking in Practice	07
	Visualisation and Ideation Challenges in idea generation, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating. Ideation Tools: How Might We? (HMW), Storyboard, Mind mapping,Brainstorming, Affinity diagram. *Activities for Tutorials* *Apply the methods of Ideate Phase: Generate Lots of Ideas.*	
5	Prototyping and Testing	08
	Prototyping Types of Prototype, Methods of prototyping, focused experiments, exploration map , minimum viable product, Testing prototypes with users *Activities for Tutorials* *Apply the Methods of the Prototype Phase: Create prototypes for selected ideas. Collect feedback, iterate and improve the ideas.*	
6	Case Studies/Real World Application	04

	Case Studies and Real World Applications Important considerations: Cross Disciplinary Collaborations,Ethical consideration, cultural sensitivity and global perspective,technology integration. *Activities for Tutorials* Find out any one use case considering the above discussed factors that have impacted the real world business/society.	
	Total	39

Textbooks:	
1	Idris Mootee, ―Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School‖, Wiley, 2017. (e-book) https://www.aitskadapa.ac.in/e-books/CSE/DESIGN%20THINKING/Design%20Thinking%20for%20Strategic%20Innovation_%20What%20They%20Can_t%20Teach%20You%20at%20Business%20or%20Design%20School%20(%20PDFDrive%20).pdf
2	Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and InspiresInnovation".(e-book) http://hozekf.oerp.ir/sites/hozekf.oerp.ir/files/kar_fanavari/manabe%20book/Thinking/Change%20by%20Design_%20How%20Design%20Thinking%20Transforms%20Organizations%20and%20Inspi res%20Innovation%20.pdf
3	Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct Publishing ISBN:978-1790435371, November 2018 (https://www.researchgate.net/publication/329310644_Handbook_of_Design_Thinking).
Reference Books:	
1	Gavin Ambrose, Paul Harris, "Basics Design - 8: Design Thinking", illustrated, reprint, AVAPublishing, 2010
2	Christine Charyton, Creative Engineering Design Assessment, Springer
3	Warren K Wake Wake, Design Paradigms: A Sourcebook for Creative Visualization, JohnWiley & Sons
Online Resources	
1	https://www.gasq.org/files/content/gasq/downloads/certification/Design%20Thinking/DesignThinking_Syllabus_0-6-3_EN.pdf
2	https://www.cuelogic.com/blog/core-principles-of-design-thinking
3	https://www.uxuiopen.com/trial/ux_fundamentals/design_process/
4	https://digitalleadership.com/blog/design-thinking/
5	https://www.interaction-design.org/literature/topics/design-thinking
6	https://www.pvpsiddhartha.ac.in/dep_it/lecture%20notes/FDLD_21/UNIT-1.pdf
7	https://aim.gov.in/pdf/Mentor-DesignThinking.pdf
1	MJV Tecnologia ltda,"Design Thinking_business innovation"e-book
2	https://theaccidentaldesignthinker.com/2017/09/16/40-design-thinking-success-stories/

3	https://voltagecontrol.com/blog/8-great-design-thinking-examples/
4	https://online.hbs.edu/blog/post/design-thinking-examples
5	https://www.theknowledgeacademy.com/blog/design-thinking-case-study/
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	User Research and Sentiment Analysis Tools:CrystalKnows, MonkeyLearn, Clarabridge
2	User Interviews and Surveys:Affectiva, Surveysparrow
3	Data Analysis Tools:Tableau, IBM Watson Analytics
4	Insight Extraction:Sift
5	Brainstorming and Idea Generation:Miro, Ideaflip, Writeseer
6	Prototyping Tools:Figma,Sketch2Code, Uizard
7	User Testing and Feedback:UserTesting, Lookback,Optimal Workshop
8	Automated Documentation and Note-Taking:Otter.ai,Notion
9	Collaboration Tools:Slack, Microsoft Teams

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Green IT

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE402	Green IT (Theory)	03	---	01	03	---	01	04

Green IT (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE402	Green IT (Theory)	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NOE402	Green IT (Theory)	20	20	60	---	---	100

Course Prerequisite: Environmental Studies	
Course Objectives:	
1	To understand what Green IT is and How it can help improve environmental Sustainability
2	To understand the principles and practices of Green IT.
3	To understand how Green IT is adopted or deployed in enterprises.
4	To understand how data centres, cloud computing, storage systems, software and networks can be made greener.
5	To measure the Maturity of a Sustainable ICT world.
6	To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial fields.
Course Outcomes: After successful completion of the course students will be able to:	
1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement.
2	Identify IT Infrastructure Management and Green Data Centre Metrics for software development.
3	Recognize Objectives of Green Network Protocols for Data communication
4	Use Green IT Strategies and metrics for ICT development.
5	Illustrate various green IT services and its roles.
6	Use new career opportunities available in the IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.

Green IT

Module	Contents	Hrs
1	**Introduction:** Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy **Hardware:** Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose **Software:** Introduction, Energy-Saving Software Techniques **Self-learning Topics:** Evaluating and Measuring Software Impact to Platform Power	07
2	**Sustainable Software development and data centres**	06
	Software, Software Sustainability Attributes, Software Sustainability Metrics Data Centers and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, Green Data Centre Metrics **Self-learning Topics:** Sustainable Software: A Case Study, Data Centre Management Strategies: A Case Study	
3	**Data storage and communication :** Storage Media Power Characteristics, Energy Management Techniques for Hard Disks Objectives of Green Network Protocols, Green Network Protocols and Standards **Self-learning Topics:** System-Level Energy Management	06
4	**Information systems, green it strategy and metrics :** Approaching Green IT Strategies, Business Drivers of Green IT Strategy Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Measuring the Maturity of Sustainable ICT: A Capability Maturity Framework for SICT, Defining the Scope and Goal, Capability Maturity Levels **Self-learning Topics:** Business Dimensions for Green IT Transformation	07

5	**Green IT services and roles:** Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware **Self-learning Topics:** Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise	06
6	**Managing and regulating green IT:** Strategizing Green Initiatives, Implementation of Green IT, Communication and Social Media The Regulatory Environment and IT Manufacturers, Non regulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Social Movements and Greenpeace **Self-learning Topics:** Information Assurance, Green Data Centers, Case Study: Managing Green IT	06
	Total	38

Textbooks:	
1	San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2013
2	Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach, Elsevier 2015
3	Reinhold, Carol Baroudi, and Jeffrey HillGreen IT for Dummies, Wiley 2009
Reference Books:	
1	Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2	Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3	Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer
Access to software and virtual labs:	
1	https://greentheweb.com/tools/

2	https://apiumhub.com/tech-blog-barcelona/green-software-tools-metrics/
3	https://climatecalculator.net/
4	https://greenit.ee/en/calculator/
5	https://natnavi.com/carbon-footprint-credit-calculator
Industry articles and case studies :	
1	https://cekh.ccreee.org/cekh_resources/virtual-labs-green-energy-energy-identify-and-quantify-different-energy-sources-for-a-home-for-csec-cape-and-cvq/
2	https://github.com/carstenwindler/green-it
3	https://www.infoworld.com/article/2640285/6-valuable-green-it-resources.html
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	OpenAI GPT Models, OpenAI Codex, OpenAI Gym, OpenAI CLIP, OpenAI DALL-E etc…
2	TensorFlow and PyTorch, Microsoft Azure AI, Google Cloud AI, Amazon AI Services, HPE GreenLake etc..

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:
Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks

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Department of Automation and Robotics

5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Department of Automation and Robotics

Database Management System

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE403	Database Management System (Theory)	03	---	01	03	---	01	04

Database Management System (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE403	Database Management System (Theory)	03	--	01	03	---	01	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NOE403	Database Management System (Theory)	20	20	60	---	---	100

Course Prerequisite: Data Structures	
Course Objectives:	
1	Collaborate effectively in teams to design and implement data-driven solutions to complex problems
2	Gain proficiency in designing, implementing, and managing relational and non-relational database management systems..
3	Explore advanced topics such as data warehousing and big data analytics..
4	Explore concepts of distributed database systems.
Course Outcomes: After successful completion of the course students will be able to:	
1	Recognize the need for a database management system
2	Understand and apply the concept of ER model and Relational Model and normalization to relational database design.
3	Construct relational models and execute SQL queries.
4	Explore advanced Database management concepts and No SQL.
5	Explore data warehousing and big data technologies
6	Understand distributed Database systems

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Department of Automation and Robotics

Database Management System

Module	Content		Hours
1	**Module 1: Introduction Database Concepts**		**02**
	1.1	Introduction, Importance of data management in organizations , DBMS system architecture, Evolution of database technologies.	
2	**Module 2: Relational Database Management Systems (RDBMS)**		**10**
	2.1	**The Entity-Relationship (ER) Model:** Entity types, Types of Attributes, Keys, Relationship constraints: Cardinality and Participation, Extended Entity-Relationship (EER) Model. **Relational Model**: Relational schema and concept of keys. Mapping the ER and EER Model to the Relational Model **Database normalization** : 1NF, 2NF, 3NF, BCNF	
3	**Module 3: SQL fundamentals**		**08**
	3.1	**Overview of SQL**: Data Definition Command with constraints, Data Manipulation commands, Data Control commands, views in SQL, joins, Nested Queries Transaction concept, Transaction states, ACID properties, Transaction Control Commands,	
4	**Module 4: Non-Relational Database Management Systems (NoSQL)**		**06**
	4.1	Types of NoSQL databases: document-based, key-value, column-family, and graph databases, Characteristics and use cases of NoSQL databases, Comparison between SQL and NoSQL databases (e.g., MongoDB, Cassandra)	**06**
5	**Module 5: Advanced Data Management Concepts**		
	5.1	Data warehousing and OLAP (Online Analytical Processing), Introduction to big data technologies (e.g., Hadoop, Spark), Data lakes and data integration strategies, Data governance and security in modern data systems.	
6	**Module 6: Introduction to Distributed Databases**		**07**

	6.1	Introduction to distributed database systems, characteristics of distributed databases, Comparison with centralized and decentralized database systems, Distributed Database Architectures, Distributed data storage: Data fragmentation, replication, and allocation strategies, Distributed transaction management : Two-phase commit protocol, Three-phase commit protocol, Data consistency and concurrency control in distributed environments.	
		Total	**39**

Textbooks:	
1	Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH
Reference Books:	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 5th Edition.
2	Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.
3	G. K. Gupta, Database Management Systems, McGraw Hill, 2012
4	Bradshaw, S., Brazil, E., Chodorow, K. (2019). MongoDB: The Definitive Guide: Powerful and Scalable Data Storage. United States: O'Reilly Media.
5	Data Warehousing Fundamentals. India, Wiley India Pvt. Limited, 2006.
6	Burns, Brendan. Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services. Japan, O'Reilly Media, 2018.
Access to software and virtual labs:	
1	https://nptel.ac.in/courses/106/105/106105175/
2	https://swayam.gov.in/nd1_noc19_cs46/preview
3	https://www.classcentral.com/course/swayam-database-management-system-9914
4	https://www.mooc-list.com/tags/dbms
5	http://vlabs.iitkgp.ac.in/se/4/simulation/
6	https://vsit.edu.in/vlab/DBMS/Views_Simulator.html
Industry articles and case studies :	

1	https://shorturl.at/NFsay:The Google File System
2	Bigtable: A Distributed Storage System for Structured Data: Google
3	https://8weeksqlchallenge.com/
4	https://docs.oracle.com/cd/E16338_01/gateways.112/e12069/ch4.htm#GMSWN300
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	Draw.io: A free, web-based tool for creating ER and EER diagrams.
2	https://dbschema.com/ :An interactive database design and management tool
3	SQLFiddle: An online tool to write and test SQL queries against different databases.
4	SQLBot: An AI tool that helps generate SQL queries from natural language inputs.

Internal Assessment:

10) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
11) Mid Term test is to be conducted when approx. 50% syllabus is completed.
12) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks

8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks
*For sr.no.7, the date of the certification exam should be within the term, and in case a student is unable to complete the certification, the grading has to be done accordingly.		

Indirect Assessment	
1	Mock Viva
2	Skill Enhancement Lecture
3	Extra Assignments/lecture

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

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Quantitative Analysis

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE404	Quantitative Analysis (Theory)	03	---	01	03	---	01	04

Quantitative Analysis
(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE404	Quantitative Analysis (Theory)	03	--	01	03	---	01	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NOE404	Quantitative Analysis (Theory)	20	20	60	---	---	100

Course Prerequisite: Quantitative Analysis	
Course Objectives:	
1	Emphasize the importance and application of quantitative methods in various fields.
2	Equip students with the skills necessary for effective data collection, organization, and management.
3	Train students in the application of inferential statistics to make predictions and generalizations about populations from sample data.
4	Teach students to calculate probabilities and apply probability distributions to real-world scenarios.
5	Ensure students can perform various data analysis tasks using these tools effectively.
Course Outcomes: After successful completion of the course students will be able to:	
1	Grasp the fundamental concepts and techniques of quantitative analysis.
2	Acquire skills in collecting, organizing, and summarizing data.
3	Apply probability concepts and various statistical methods to analyze data.
4	Understand the applications of mathematical models in real-world scenarios.
5	Understand the application of software tools in analyzing and visualizing data.
Learning Outcomes:	
1	Apply quantitative methods accurately to solve real-world problems in various fields.
2	Efficiently organize, summarize, and interpret data using statistical tools and techniques.
3	Use descriptive statistics to provide meaningful summaries of data sets.
4	Conduct and interpret hypothesis tests and confidence intervals.
5	Interpret and use the results of mathematical models in decision-making processes.

Quantitative Analysis

Module	Contents	Hrs
1	**Basic Concepts, Operation Research and its role in Decision Making**	6
	Introduction to Quantitative Analysis: Basic concepts and its role in decision making, Nature of OR problem, steps in OR problem, Formulation of LP problems, Solution of L.P.P. by Graphical Method, Computer Output	
2	**Duality and Sensitivity Analysis**	6
	Duality and its implications, Sensitivity analysis (Computer Output Analysis), Introduction to Integer programming, Goal programming problems (Only formulation and solution of two variable cases)	
3	**Transportation and Network Problems**	6
	Transportation Models, Initial Basic Feasible Solution and Optimal Solution, Assignment Problem and Travelling Salesman Problem, Network Models: minimum Spanning Tree Problems, Shortest Route and Maximal Flow Technique	
4	**Queuing Theory and Simulation Models**	6
	Queuing theory: Single Channel Queuing Model with Poisson arrivals and Exponential Service Times (M/M/1) , Simulation Modelling, Markov Analysis	
5	**Software Usages**	6
	Practical Module: Use of Excel Solver/TORA software to solve above problems and teaching the above concepts using at least one case in each topic	
6	**Data & Statistics**	9
	An Overview: Visualizing Data, Probability , Describing Distributions with Numbers ,Normal Distributions ,Sampling Distributions, Interval Estimation for a Population Mean, Hypothesis Testing for a Population Mean (σ known), Hypothesis Testing for a Population Mean (σ unknown)	
	Total	39

Reference Books:	
1	Barry Render, Ralph M. Stair, Jr., Michael E. Hanna, T N Badri, Quantitative Analysis for Management, Pearson.
2	Vohra N. D., Quantitative Techniques in Management, Tata McGraw Hill.
3	J. K. Sharma, Operation Research – Theory & Applications, MACMILLAN.
Access to software and virtual labs:	
1	Excel, R, Python

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks
*For sr.no.7, the date of the certification exam should be within the term, and in case a student is unable to		

complete the certification, the grading has to be done accordingly.

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Web Development

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE405	Web Development (Theory)	03	---	01	03	---	01	04

Web Development (Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NOE405	Web Development (Theory)	03	--	01	03	---	01	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NOE405	Web Development (Theory)	20	20	60	---	---	100

Course Objectives:	
1	Understand the foundational concepts of web development including front-end and back-end distinctions, and basic technologies like HTML, CSS, and JavaScript.
2	Develop proficiency in creating static web pages using HTML and CSS, including structuring documents, working with links, images, and forms, and applying CSS styling techniques.
3	Gain knowledge and skills in responsive web design principles and practices, including media queries, flexible grids, and CSS frameworks like Bootstrap.
4	Acquire fundamental understanding of JavaScript programming, covering variables, data types, control structures, functions, DOM manipulation, and event handling.
5	Explore backend development concepts with Firebase and Node.js, including setup, database integration, web server creation, and RESTful API development.
6	Familiarize yourself with tools and technologies for Express web development, including Gatsby, GraphQL, static site generation, styling, optimization, and deployment strategies.
Course Outcomes: After successful completion of the course students will be able to:	
1	Demonstrate the ability to create basic static web pages using HTML and CSS, incorporating links, images, forms, and applying styling techniques.
2	Design responsive web layouts utilizing media queries, flexible grids, and CSS frameworks, ensuring compatibility across various devices and screen sizes.
3	Implement interactive features on web pages using JavaScript, including dynamic content updates, event-driven behavior, and user interaction.
4	Develop backend solutions using Firebase and Node.js, integrating authentication, databases, and RESTful APIs to support dynamic web applications.
5	Construct and deploy web applications using Express.js, employing routing, middleware, and server-side logic for efficient handling of HTTP requests and responses.
6	Utilize Gatsby and associated technologies for building optimized, serverless web applications, leveraging GraphQL, static site generation, and deployment best practices.

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Web Development

Module	Content		Hours
1	**Introduction to Web Development**		**06**
	1.1	Introduction to the World Wide Web, Front-end vs. back-end development, Overview of HTML, CSS, and JavaScript, Introduction to version control with Git, Setting up development environment (text editor, browser, Git)	
2	**HTML and CSS Fundamentals**		**07**
	2.1	HTML basics: tags, elements, attributes, Document structure: headings, paragraphs, lists, Working with links and images, Forms, CSS fundamentals: selectors, properties, values, Styling text, colors, backgrounds, and borders, CSS box model: margin, padding, border, Layout techniques: floats, positioning, flexbox	
3	**Responsive Web Design**		**06**
	3.1	Introduction to responsive web design principles, Using media queries to create responsive layouts, Flexible grids and fluid images, CSS frameworks for responsive design (e.g., Bootstrap), Testing and debugging responsive websites	
4	**Introduction to JavaScript**		**07**
	4.1	Introduction to JavaScript: Variables, data types, operators, Control structures: loops and conditionals, Functions and scope, DOM manipulation: selecting elements, modifying content and attributes, Event handling: responding to user actions	
5	**Introduction to Backend Development**		**09**
	5.1	Introduction to Firebase, Firebase Authentication, Realtime Database or Firestore	
	5.2	Introduction to backend development and Node.js, Setting up a Node.js development environment, Building a simple web server with Node.js, **Introduction to Express.js framework**, Routing and middleware in **Express.js,** Handling HTTP requests and responses, Introduction to RESTful APIs	
6	**Tools for Express Web Development**		**04**

	6.1	Gatsby : GraphQL, Static Site Generation (SSG), Plugins, Styling in Gatsby, Optimization Techniques. Deployment, Serverless Functions.	
		Total	**39**

Textbooks:	
1	Ralph Moseley, M.T. Savliya, "Developing Web Applications", Willy India, Second Edition, ISBN: 978-81-265-3867-6
2	Web Technology Black Book, Dremtech Press, First Edition, 978-7722-997
3	Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY, 2014. (http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascript_CSS_HTML5 Robin_Nixon_3e.pdf)
4	Dana Moore, Raymond Budd, Edward Benson,Professional Rich Internet Applications: AJAX and Beyond Wiley publications. https://ebooks-it.org/0470082801-ebook.htm
5	Alex Banks and Eve Porcello, Learning React Functional Web Development with React and Redux,OREILLY, First Edition
Reference Books:	
1	Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, Internet and World Wide Web - How To Program, Fifth Edition, Pearson Education, 2011.
2	Achyut S Godbole and AtulKahate, —Web Technologies, Second Edition, Tata McGraw Hill, 2012.
3	Thomas A Powell, Fritz Schneider, —JavaScript: The Complete Reference, Third Edition, Tata McGraw Hill, 2013
4	Masse, M. (2011). REST API Design Rulebook. Germany: O'Reilly Media.
5	Porcello, E., Banks, A. (2018). Learning GraphQL: Declarative Data Fetching for Modern Web Apps. China: O'Reilly Media.
Useful Links	
Resources	
1	MDN Web Docs - JavaScript
2	React Documentation
3	Node.js Documentation
4	Express.js Documentation
5	MongoDB Documentation
6	PostgreSQL Documentation
1	Code Generation and Assistance: GitHub Copilot, TabNine
2	Testing and Debugging: DeepCode, Snyk

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3	Automated Code Review: Codacy, SonarQube
4	Performance Optimization: LightStep, Datadog APM
5	Front-End Development: Figma with AI Plugins, Adobe XD with AI Features
6	Back-End Development: AWS CodeGuru, Kite
7	Database Management: DataRobot, OtterTune
8	DevOps and Deployment: Ansible with AI, Harness.io
9	Project Management and Collaboration: Asana with AITrello with AI Plugins
10	Documentation: Jasper (formerly Jarvis), Scribe

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks

7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks
*For sr.no.7, the date of the certification exam should be within the term, and in case a student is unable to complete the certification, the grading has to be done accordingly.		

Indirect Assessment	
1	Mock Viva
2	Skill Enhancement Lecture
3	Extra Assignments/lecture

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

***Tutorials:** At least six tutorials, covering the entire syllabus should be conducted during tutorial hours.

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Introduction to Innovation and Entrepreneurship for Engineers

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NAREM41	Innovation and Entrepreneurship for Engineers (Theory)	02	---	--	02	--	--	02
Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
	Innovation and Entrepreneurship for Engineers (Theory)							

(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NAREM41	Introduction to Innovation and Entrepreneurship for Engineers (Theory)	02	---	--	02	--	--	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				

NAREM41	Introduction to Innovation and Entrepreneurship for Engineers (Theory)	–	–	–	**25**	–	**25**

Course Prerequisite:	
Course Objectives:	
1	Understand the concepts and theories of innovation and entrepreneurship within engineering disciplines.
2	Develop critical thinking and problem-solving skills necessary for identifying and evaluating entrepreneurial opportunities.
3	Gain practical experience in ideation, prototyping, and validation of innovative solutions to engineering challenges.
4	Explore the role of engineering in addressing societal and environmental challenges through innovation and entrepreneurship.
5	Cultivate teamwork, communication, and leadership skills essential for entrepreneurial success in interdisciplinary contexts.
Course Outcomes: After successful completion of the course students will be able to:	
1	Understand principles of innovation and entrepreneurship.
2	Identify and evaluate entrepreneurial opportunities.
3	Understand and Apply design thinking and innovation methodologies.
4	Develop and validate viable business models and innovative solutions.
5	Understand and demonstrate ethical practices in innovation and entrepreneurship
6	Demonstrate entrepreneurial mindset and skills.

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Introduction to Innovation and Entrepreneurship for Engineers (Theory)

Module	Contents	Hrs
1	Introduction to Innovation and Design Thinking	06
1.1	Overview of innovation concepts and importance in engineering.	
1.2	Types of innovation and innovation processes.	
1.3	Introduction to design thinking methodology.	
1.4	Applying design thinking principles to engineering challenges.	
1.5	Empathy mapping and user journey analysis.	
1.6	Iterative design process and user testing.	
2	Opportunity Identification, Ideation	04
2.1	Techniques for identifying customer needs and pain points.	
2.2	Idea generation exercises and brainstorming sessions.	
2.3	Problem-solving through human-centered design.	
3	Prototyping and MVP Development	04
3.1	Introduction to prototyping techniques and tools.	
3.2	Minimum viable product (MVP) development and validation.	
3.3	Rapid iteration and feedback gathering.	
4	Introduction to Entrepreneurship	04
4.1	Overview of entrepreneurship concepts and mindset.	
4.2	Role of entrepreneurs in driving economic and social change.	
4.3	Characteristics of successful entrepreneurs. - Case Studies	
5	Business Model Innovation and Validation	04
5.1	Introduction to business model canvas and value proposition design.	

5.2	Revenue models, pricing strategies, and cost structure analysis.	
5.3	Techniques for market research and customer validation.	
5.4	Identifying target markets and understanding customer needs.	
6	Legal and Ethical Considerations	04
6.1	Intellectual property rights and patents in engineering innovation.	
6.2	Ethical considerations in entrepreneurship and engineering practice.	
6.3	Social responsibility and sustainability in innovation and entrepreneurship.	
	Total	**26**

Textbooks:	
1	"Entrepreneurship Development and Small Business Enterprises" by Poornima M. Charantimath
2	"Innovation and Entrepreneurship: Practice and Principles" by Peter F. Drucker
3	"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" by Alexander Osterwalder and Yves Pigneur
4	"Innovative India: Science and Technology Entrepreneurship" by K. Vijayaraghavan and Rajan Srikanth
5	"Startup Nation: Making India a Startup Ecosystem" by Dr. H.K. Mittal
6	"Entrepreneurship: Theory, Process, and Practice" by Kuratko, Hornsby, and Covin:
7	"Zero to One: Notes on Startups, or How to Build the Future" by Peter Thiel and Blake Masters
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	Startup India (startupindia.gov.in): ● Provides resources, guidelines, and support for startups and entrepreneurs in India, including information on funding, policies, and events.
2	National Entrepreneurship Network (NEN) (wadhwanifoundation.org/national-entrepreneurship-network): ● Offers resources, workshops, and programs for entrepreneurship education and ecosystem development in India.
3	MIT OpenCourseWare (ocw.mit.edu): ● Offers free online courses on entrepreneurship and innovation, including lecture notes, assignments, and case studies from MIT's entrepreneurship curriculum.

4	Stanford eCorner (ecorner.stanford.edu) • Features a rich collection of videos, podcasts, and articles on entrepreneurship and innovation from Stanford University, including talks by successful entrepreneurs and industry experts.
5	Coursera (coursera.org) • Provides online courses on entrepreneurship and innovation from top universities and institutions, allowing students to learn at their own pace and earn certificates.
6	TiE (The Indus Entrepreneurs) (tie.org) • A global nonprofit organization dedicated to fostering entrepreneurship through mentoring, networking, and education, with many chapters in India offering local support and events.
1	Entrepreneurship Development Institute of India (EDII) (ediindia.org) • Provides entrepreneurship education, training, and research programs, as well as workshops and seminars on various aspects of entrepreneurship.
2	Harvard Business Review (hbr.org) • Offers articles, case studies, and insights on innovation, entrepreneurship, and business strategy from industry experts and thought leaders.
3	Khan Academy (khanacademy.org) • Offers free educational resources, including lessons on entrepreneurship, economics, and business fundamentals.

Internal Assessment:

1) Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.
2) Mid Term test is to be conducted when approx. 50% syllabus is completed.
3) Duration of the midterm test shall be one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:

Sr. No	Rubrics	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks

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2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8.	Multiple Choice Questions (Quiz)	05 marks
9.	Peer Review and participation the marks can be left blank (with discretion of faculty)	05 Marks

End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will have a total of five questions
3	All questions have equal weightage and carry 20 marks each
4	Any three questions out of five need to be solved.

Term Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

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Field Project

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARFPL41	Field Project	--	04	-	--	02	--	02

(Theory)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
NARFPL41	Field Project	--	04	–	--	02	--	02

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
NARFPL41	Field Project	–	–	–	50	–	50

Course Prerequisite:	
1	Basic Electrical Engineering
2	Electronic Devices and Circuits
3	Digital System Design,
4	Linear Integrated Circuits
Course Objectives:	
1	To engage students in field visits, with an objective of identifying and formulating problem statements based on observations during visits in industry, Government/ Non governmental organizations as well as the broader societal context. **(with reference to Scheme A).** Students engage in experiential learning through developing industry or organizational case studies, analysing real-world processes, and proposing innovative enhancements based on critical observations and analysis **(with reference to Scheme B).** This approach bridges academic theory with practical application, fostering deeper understanding and actionable insights for students.
2	To apply theoretical knowledge and foster creativity & innovation in addressing practical real-world problems.
3	To enhance student's analytical, design & problem-solving skills, increase student's critical thinking ability to engage them in lifelong learning.
4	To develop teamwork skills to achieve project goals and deadlines.
Course Outcomes: After successful completion of the course students will be able to:	
1	To identify and resolve the issues with industry & society at large, to provide practical solutions for real-world challenges.
2	To implement novel and efficient solutions fostering interdisciplinary collaboration in addressing challenges
3	To apply appropriate techniques, resources and modern engineering tools, to improve the analytical, design, and problem-solving skills to abreast with the booming technologies.
4	Cultivation of effective teamwork abilities, facilitating collaboration and synergy among individuals to achieve common goals.

Field Project (Theory)

1		**Project Planning and Proposal Development:** Defining project objectives and scope, conducting literature review and background research, developing project proposal and timeline, Identifying required resources and constraints.	**6**
2		**Design and Implementation:** Selecting appropriate methodologies and Simulation tools, designing system architecture and components, Prototyping and testing system functionalities, iterative development and troubleshooting.	**6**
3		**Documentation and Reporting:** Maintaining detailed project documentation, Recording progress, challenges and solutions, Writing technical reports and documentation, Creating presentations for project updates and final presentation.	**6**
4		**Project Presentation and Evaluation:** Delivering oral presentations of project progress, Demonstrating project outcomes and achievements, responding to questions and feedback from peers and instructors, reflecting on lessons learned and areas for improvement.	**6**
		Total	**24**

Term Work:	
1	**Guideline to maintain quality of field project are as follows :** Students can achieve this by making proper selection of projects based on field visit/ study of archives from the library. Encourage the use of open source softwares for simulation, design and documentation of the projects. **Project Topic selection and approval :-** 1. The group may be of maximum **FOUR (04)** students. 2. The students are required to visit industry/community/library to identify the problem statement and be able to provide the proof of interaction. 3. Topic selection and approval by **2 Expert** faculty from the department at the start of semester. 4. **Log Book** to be prepared for each group to record the work per week by students. Weekly comment, remarks to be put by guiding faculty. Both students and faculty will put signatures in it per week. The log book can be managed **online** with proper authentication methods using google sheets/forms or open source project management software. **5. Suggested steps for project selection and implementation as per scheme A.** a. After identification of a problem statement during field visit, it is mandatory to design (analog+digital) sensor/IC based circuit on PCB in the project. Pure software projects will not be allowed. b. Application is made using PCB + Arduino (IDE)/ ESP32/Basic Raspberry-pi board. (Hardware + software co-design). (Project should be completely hardware based with minimal software use). c. Identification and testing of different components, instruments, simulation software for projects. d. Topic selected should be application based. The chosen topic should not belong to the existing experiment list with medium/high difficulty level of implementation. e. Designing and analyzing circuits by students using standard material and software. f. Initial project demonstration and testing is expected to be done by soldering on general purpose PCB. Discourage use of breadboards. g. Study of PCB, Simulation on software and making of final PCB layout for given circuit. h. Implementing the final circuits on PCB by mounting required components with application using Arduino. 6. Suggested list of components : Transistors, diodes, regulators, gates, counters, FF, Latches, Decoder, Mux, comparator, Adder, Subtractor, ALU, CPLDs, DC motors, resistor, capacitor, inductor, Op-amp etc.(Students may add more components as per the requirement of project)

2	**Project Report Format:** 1. Project **report** should include the objectives, circuit diagram, operation, application, waveforms (if applicable), simulation results and final prepared PCB image, conclusion and references etc. 2. Report should not exceed **20 pages** and spiral binding is not required.
3	The final certification and acceptance of term work ensures satisfactory performance of project work and minimum passing marks in term work.
4	**Term Work evaluation and marking as per Scheme A:** 1. At the end of semester the above 2 expert faculty who have approved the topic will internally **evaluate the performance**. 2. Students have to give a presentation and demonstration on the Field Project. 3. In the evaluation each individual student should be assessed for his/her contribution, understanding and knowledge gained about the project completed. Based upon it the marks will be awarded to students. **4. <u>Distribution of 50 Marks for Term Work</u>:** • **Initial Stage** : Field study report and Project Proposal = **10** Marks • **Circuit simulation/** Zero PCB (GPP) implementation + Arduino Interfacing = **05** Marks o **(Project review:** Stage 1 and 2 will be evaluated in 3rd or 4th week of the semester). • **Project report**: Circuit Design + Explanation + Analysis Results + Conclusion + References = **10** Marks • **Prototype Demonstration and Testing:** PCB (simulation + Layout) + Final result with Arduino interfacing / ESP32/Basic Raspberry-pi board.+ Working Demo = **15** Marks • **Final Presentation and Report**: PPT (upto **12** slides) + Answers given to Questions = **10** Marks
	Project selection, implementation and report writing with reference to Course Description B. The student will mention the objectives of the field visit, description including field visit data collection, processes/ operations, analysis and suggestions for the improvement and innovations if any. **<u>Distribution of 50 Marks for Term Work in scheme B is as follows:</u>** **1.** Assessment of case study report with analysis prepared by student groups: **25 marks** 2. Presentation by student groups and Q&A: **15 marks**

	3. Suggestions given for improvement in the present Processes/ Systems / Operations, innovation identification: **10 marks.**

Skill Lab -1 Embedded Systems

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
NARVEL41	Skill Lab -1 Embedded Systems (Lab)	01	02	---	01	01	---	02

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
NARVEL41	Skill Lab -1: Embedded systems	01	02	---	01	01	---	02

Course Code	Course Name	Examination Scheme					
		Theory					
		Internal Assessment		End Sem Exam	Term Work	Practical & Oral	Total
		Mid-Term Test	Continuous Assessment				
NARVEL41	Skill Lab -1: Embedded systems	-	-	-	25	25	50

Course Prerequisite:	
Course Objectives:	
1	Understand the concept of embedded system, microcontroller, different components of microcontroller and their interactions .
2	Get familiarized with the programming environment to develop embedded solutions.
3	Program 8051 microcontroller to perform various tasks
4	Understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.
Course Outcomes: After successful completion of the course students will be able to:	
1	Construct programs in Embedded C for the 8051 microcontroller.
2	Connect digital and analog components to the 8051, ensuring proper data interaction
3	Implement communication protocols (UART and I2C) to facilitate data exchange with the 8051 microcontroller.
4	Create systems by applying advanced 8051 architecture features.

Sr.No	Topic	Hrs
1	Understanding Advanced 8051 architectures, Code Blocks IDE , Embedded SDCC compiler, programming tools and its configuration	8
2	Introduction to Embedded Systems Embedded C Programming Data types, Memory Allocation and Interrupt handling	8
3	Interfacing Digital Sensor and Actuators to 8051 Interfacing a Led and blinking an Led Interfacing a Button and taking care of debouncing Interfacing a Relay and controlling external Devices	8
4	Interfacing Analog Sensors with 8051. Interfacing a Potentiometer and reading the voltage Interfacing a LDR and measuring the light Intensity	8

	Interfacing a Thermistor and measuring the Temperature	
5	Communicating using UART Baud Rate, Receive and Transmit data Interfacing devices using I2C protocol Interfacing Display device using I2C	8
6	Designing a Temperature based Controller using 8051	12
	Total	52

Textbooks:	
1	Kenneth J. Ayala, "The 8051 Microcontroller Architecture, Programming and Application", Penram International Publications, Fourth Edition 2009
2	Raj Kamal, "Microcontrollers" Architecture, Programming, Interfacing and System Design", Pearson Education, Second Edition 2012
3	Muhammad Ali Mazidi, Janice GfillispieMazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, LPE 10th reprint 2012

Term Work (25 Marks):	
1	At least 12 experiments and 01 course projects should be performed.
2	Term work assessment must be based on the overall performance of the student with every experiment and project graded from time-to time.
3	The grades will be converted to marks as per "Credit and Grading System" manual and should be added and averaged.
4	Based on the above scheme grading and term work assessment should be done.
5	The practical and oral examination will be based on entire syllabus