

ACADEMIC CURRICULA

**POST GRADUATE DEGREE
PROGRAMMES**

Master of Technology

(Choice Based Flexible Credit System)

Regulations 2021

Volume – 27
Syllabi for Common Courses



SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

**Kattankulathur, Chengalpattu District 603203, Tamil Nadu,
India**

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Syllabi for Common Courses

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ACADEMIC CURRICULA

Professional Core Courses

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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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**Kattankulathur, Chengalpattu District 603203, Tamil Nadu,
India**

Course Code	21IPC501J	Course Name	RESEARCH METHODOLOGY	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							2	1	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	College of Engineering and Technology	Data Book / Codes/Standards	Statistical data book and tables		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the different methodologies involved in research studies
CLR-2:	familiarize with various types of academic writing and presentations
CLR-3:	understand the significance of ethics in academic publications
CLR-4:	familiarize with different design of experiments and optimization techniques
CLR-5:	familiarize with approaches of analysing data

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	acquire knowledge on basic research methodology	3	3	-
CO-2:	write and present research contents	3	3	-
CO-3:	recognise the values and ethic involved in scientific research	3	3	-
CO-4:	apply different approaches for solving design of experiments and optimization problems	3	2	-
CO-5:	analyse the applications of statistical and machine learning tools for data analysis	3	2	-

Module-1 – Research Preparation, Planning and Resources	16 Hours
Research – objectives, definitions – knowledge economy; Perspectives of stakeholders; Types of research; Critical and creative thinking; Generating research topic; Identifying broad research question and objectives – design of questionnaire; Characteristics of a good research – research design; Methods of scientific enquiry – theoretical, experimental and empirical; Hypothesis – formulation and testing. Sources of information – ICT enabled tools; Databases, repositories, public and private sources, indexes; Literature search – keyword; Backward and forward search; Quality measurement tools: journal metrics, author-level metrics; Meta-analysis of research findings; Literature review: grouping, analysing and comparison: Identification of research Methods; Intellectual Property Rights; Copyright – patent –geographical indication – industrial designs – technology transfer. PRACTICE: Identifying research topic and formulation of Research Statement; Conduction of literature review.	
Module-2 – Academic Writing and Presentations	14 Hours
Preparation of project proposal for funding – Identification of funding agencies; Project proposals structure; Research report writing; Data visualization; Communication model – audience analysis; Identification of suitable journal; Conference presentation types: Oral, poster – difference in audience interaction – guideline for effective presentation; Synopsis – thesis – extended abstract – graphical and video abstract – short communications; Referencing – style – tools for referencing; Thesis writing: structure – preliminary pages, main body, references; Evaluation of Thesis – examiner reports – Oral defense. PRACTICE: Writing abstract and conclusion; Referencing in different styles.	
Module-3 – Publication Ethics and Misconducts	12 Hours
Ethics: definition; Ethics with respect to science and research - intellectual honesty and research integrity; Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP); Redundant publications: duplicate and overlapping publications, salami slicing; Selective reporting and misrepresentation of data; Publication ethics: introduction and importance; Standards setting initiatives and guidelines: COPE, WAME; Conflicts of interest. Publication misconduct: definition, concept, unethical behaviour; Violation of publication ethics, authorship and contributor ship; Identification, complaints and appeals; Predatory publisher and journals. PRACTICE: Plagiarism checking and rectification.	
Module-4 – Design Of Experiments and Optimization Methods	16 Hours

Design of experiments; Basic experimental designs; Completely randomized design; Randomized block design; Latin square design; Full factorial design - 2², 2³ and 2^k; Fractional factorial designs; Taguchi methodology – Orthogonal array; S/N ratio – Taguchi method for optimization; Response surface method – multi response optimization. Global optimization techniques – evolutionary and swarm algorithms – examples and case studies.

PRACTICE: Design of experiment – Taguchi method – Response surface method.

Module-5 – Data Analysis

17 Hours

Basic probability distributions – Normal distribution – Binominal and Poisson distributions – Weibull and exponential distributions; Sampling: types - size, Sampling tests: T-test – F-test – χ^2 test; Modelling – validation and verification; Simulation – techniques; ANOVA; Correlation analyses: Pearson and Spearman Correlations; Regression, classification and cluster analyses; Factor analysis; Discriminant analysis; Uncertainty and error analyses; Machine learning: supervised and unsupervised – examples and case studies.

PRACTICE: Distribution; Sampling; Machine learning tools.

Learning Resources	1. Ganesan, R. (2020), <i>Research Methodology for Engineers</i>, MJP Publishers, Chennai. 2. Kothari, C.R. & Garg, G. (2022), <i>Research Methodology</i>, New Age International Publishers, New Delhi. 3. Singh, U.P., Ahlawat, S. & Sharma, S. (2023), <i>Research and Publication Ethics</i>, S.Chand & Co. Ltd., New Delhi. 4. Mukerjee, S.P. (2020), <i>A Guide to Research Methodology: An Overview of Research Problems, Tasks and Methods</i>, CRC Press, New York. 5. Bairagi, V. & Munot, M.V. (2019), <i>Research Methodology: A practical and scientific approach</i>, CRC Press, New York. 6. Locharoenrat, K. (2017), <i>Research Methodology for beginners</i>, CRC Press, New York. 7. Panneerselvam, R. (2014) <i>Research Methodology</i>, R., PHI Learning Pvt Ltd, New Delhi. 8. Upagade, V. & Shende, A. (2010), <i>A. Research Methodology</i>, Vijay, S.Chand & Co. Ltd., New Delhi. 9. Alvi, M.H. (2016), <i>A Manual for Referencing styles in Research</i>, University of Karachi, Pakistan. 10. Steneck, N.H. (2007). <i>Introduction to the Responsible Conduct of Research</i>. Office of Research Integrity. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf 11. Adams, K.A., and Lawrence, E.K. (2019), <i>Research Methods, Statistics and applications</i>, Sage Publication, Thousand ORKS, California, USA 12. Gastel, B., and Day, R.A. (2016), <i>How to Write and Publish a Scientific paper</i>, 8th Edition, Greenwood, California 13. Kornuta, H.M., and Germaine, R.W., (2006), <i>A concise guide to writing a Thesis or Dissertation</i>, 2nd Edition, Taylor & Francis Group, New York 14. Montgomery, D.C., (2013), <i>Design and Analysis of Experiments</i>, 8th edition, Wiley, New Delhi. 15. Box, G.E.P. and Draper N.R, (2007) <i>Empirical Model-Building and Response Surfaces</i>, John Wiley & Sons. 16. Antony, J., (2014), <i>Design of Experiments for Engineers and Scientists</i>, Second Edition, Elsevier, Amsterdam. 17. Das, M.N. and Giri, N.C., (2003) <i>Design and Analysis of Experiments</i>, New Age International (P) Limited, New Delhi. 18. Chopra, R. (2018), <i>Machine Learning</i>, Khanna Book Publishing, New Delhi.
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (45%)		Life-Long Learning CLA-2 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	-	10%	20%	-
Level 2	Understand	20%	-	-	10%	20%	-
Level 3	Apply	30%	-	-	40%	30%	-
Level 4	Analyze	30%	-	-	40%	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Dr. Shubaprabha Datta, SRMIST
		2.

Course Code	21ASC601T	21AUC601T	21BMC601T	Course Name	CASE STUDIES	Course Category	C	PROFESSIONAL CORE	L	T	P	C
	21BTC601T	21CEC601T	21CHC601T									
	21CSC601T	21FPC601T	21GEC601T									
	21ECC601T	21EEC601T	21EIC601T									
	21MEC601T	21MHC601T	21NTC601T						3	0	0	3

Pre-requisite Courses	<i>Nil</i>	Co- requisite Courses	<i>Nil</i>	Progressive Courses	<i>Nil</i>
Course Offering Department	<i>All</i>	Data Book / Codes / Standards	<i>Nil</i>		

Course Learning Rationale (CLR):	<i>The purpose of learning this course is to:</i>
CLR-1:	<i>provide students with the opportunity to in depth study of a problem or issue to get a multifaceted view</i>
CLR-2:	<i>provide the opportunity to gather information related to the problem through different sources</i>
CLR-3:	<i>analyze concrete data, and then view it, and apply theoretical knowledge in real-life situations</i>
CLR-4:	<i>prepare a technical report and present in a professional manner</i>

Course Outcomes (CO):	<i>At the end of this course, learners will be able to:</i>	Programme Outcomes (PO)		
		1	2	3
CO-1:	<i>investigate a problem or situation and use analysis and theory to recommend a solution.</i>	3	3	
CO-2:	<i>Analyse the collected data or information using suitable tools</i>	2	3	
CO-3:	<i>develop decision making and problem-solving skills</i>	2	3	
CO-4:	<i>compile the output in a professional way and present it to the society</i>	3	3	

Case study facilitates students in gaining profound insights into the subject matter while acquiring practical knowledge. Case study creation helps to evolve creative thinking, analytical skills, and reasoning abilities.				
- Case study can be carried out in the institute or an industry or research center outside of SRMIST. - The case study should be aligned with one of the Sustainable Development Goals (SDGs) that aim to transform our world. - Periodic reviews may be conducted to monitor the progress of the course. During the reviews, Students should present and demonstrate their work. - After completion of the case study, the students shall submit a report and undergo the assessment process				

	Continuous Learning Assessment			
	(100% weightage)			
	<i>Review - 1</i>	<i>Review - 2</i>	<i>Report</i>	<i>Final Presentation</i>
<i>Case study</i>	30 %	30 %	10 %	30 %

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Professional Elective Courses

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**Kattankulathur, Chengalpattu District 603203, Tamil Nadu,
India**

Course Code	21IPE502T	Course Name	VEHICLE DIAGNOSTICS SYSTEMS	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards	NA		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	study the need of diagnostic system and its standards
CLR-2:	explore the testing modes of on-board diagnostics
CLR-3:	discuss the various diagnostic devices and its diagnostic systems
CLR-4:	discuss the chassis diagnostic system modules
CLR-5:	explore the significant of vehicle maintenance and service

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	comprehend the concepts of diagnostic system	3	2	
CO-2:	discuss the modes of on-board diagnostics	3	2	
CO-3:	analyze the practical process of diagnostic system	3	2	
CO-4:	explore the modules in chassis system diagnostics		2	3
CO-5:	discuss the architecture and components of advanced vehicle diagnostic system		2	3

Module-1 – Introduction to Diagnostic System	7 Hour
Need for maintenance - types of maintenance: preventive and breakdown maintenance - requirements of maintenance - preparation of check lists – Inspection schedule - maintenance of records – log sheets and other forms - safety precautions in maintenance: General safety - tool safety - Diagnostic Techniques needs – history for traditional vehicle to modern vehicles and necessity – diagnostic process - diagnostics on paper - mechanical diagnostic techniques - electrical diagnostic techniques (internal components and their systems) – Overview of diagnostics system in ECU – Diagnostic control system architecture in vehicles ECU, CAN with respect to the diagnostic system and its features - inter system (Types of CAN) ECU diagnostics - error detection - diagnostic protocols – UDS (Unified diagnostic services) - Diagnostic standards (SAE, ISO, AIS etc.)	
Module-2 :- On-Board Diagnostics	7 Hour
On and off-board diagnostics - Origin of OBD – K-line, Serial communication protocols - OBD port - SAE J1979 - fault codes - Anatomy of DTC - fault analysis based on DTC - Types of the faults codes and its characteristics features – Data sources – Components of OBD- SI/CI engine OBD monitors – OBD types - OBD II modes – MIL - freeze frame data and fault memory-future development in diagnostic system - Data identification - Error snapshot - Limp home mode operation and its features	
Module-3 – Diagnostic Devices (On board /offboard) -Practical Diagnostics System and Conventional Powertrain System Diagnostics	12 Hour
Scanning tools PC based - IOT and others - Basic equipment - Oscilloscopes – Scanners - ECU hardware tester - Gateway tester, ETAS, HIL for diagnostic system, Scan tool interface – ECU Programming and the ODX standard, Initial and reprogramming of ECU - End of Line (EOL) features - Flash programming in vehicle line production - Diagnostic programming process of ECU supplier – Diagnostic updates (OTA)for the vehicle software - Workshop tester and Vehicle application for the diagnostic system testing with case studies examples (Renault, Nissan, Volvo etc.) Diagnostics of Engine operation – Engine management system diagnostic system architecture (CI and SI engine, Gaseous fuels) – Engine fault diagnostic table – Fuel system - Misfire detection - Ignition and Oxygen sensors - After treatment related fault- Emission - Fuel Injection - Diesel injection - Engine management - Fault finding information - air supply and exhaust systems - cooling - lubrication - batteries - starting system - charging system .	
Module-4 – Chassis System Diagnostics	7 Hour

Chassis system diagnostic (brake, steering and suspension, TPMS etc.) – fault codes and types of faults in chassis system - Basic equipment - Oscilloscopes -Scanners - Fault code readers - Other components - Diagnostics monitors perspective of ABS, ESP and TCS, Safety related (active and passive safety system) diagnostic protocols and types of fault codes and their remedies. Electronic components and circuits diagnosis - power distribution system faults - multiplexing - lighting - diagnosing auxiliary system faults - in car entertainment security and communication - body electrical system faults - diagnosing instruments cluster faults - HVAC diagnostics, steering control, wiper system diagnostics, Vehicle key system and immobilizer related diagnostics.

Module-5 – Vehicle maintenance/service and Advanced Vehicle Systems Diagnostics

12 Hour

Servicing and maintenance of engine: Dismantling of engine components: Conventional and gaseous fuel engines - cylinder head - valve train - cylinder block - connecting rod – piston and crankshaft assembly; cleaning and inspection of engine components - reconditioning of components - Servicing and maintenance of fuel system - Engine tune-up, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Anticorrosion and anti-freeze additives. Servicing and maintenance of Drive train system: clutch - gear box – transfer case - universal joints - CV joints - propeller shaft - final reduction –differential system, and rear axles. Servicing and maintenance of chassis system: Service and maintenance of brake – disc and drum brakes - front axle - steering systems – wheel alignment and suspension systems - Vehicle body maintenance - Steering system. Diagnostic architecture of the Electric vehicle motor control – Maintenance – Fault diagnosis and repair/replacement - Power electronic related diagnostic system faults and remedies - Electric Vehicle Drive Train diagnostic standards and scan tool - BMS related faults - Battery pack and Charging system diagnostic characteristics and architecture of working - types of faults in EV powertrain - Certification and standards for EV powertrain diagnostics process - HEV related EMS diagnostics features - ADAS related diagnostic testing standards and protocols - fault codes identifications and rectification process - ADAS scan tools. Data analytic, machine learning and deep learning in Diagnostics, Predictive and prescriptive Diagnostics, remote Diagnostics-AR/VR for remote Diagnostics.

Learning Resources	1. Tom Denton, “Advanced Automotive Fault Diagnosis: Automotive Technology: Vehicle Maintenance and Repair”, 5th Edition; September 2020, Routledge	4. Peter Subke, “Diagnostic Communication with Road-Vehicles and Non-Road Mobile Machinery”, ISBN:9780768002980, SAE International, 2019
	2. Asoro Osasumwen, “Automotive Computerized and Electrical Diagnostics Technology: The Use of Automotive Diagnostic Tools, Independently Published, ISBN:9798650645801, 2020	5. Marscholik C, Subke P. Road Vehicles: Diagnostic Communication: Technology and Applications. Laxmi Publications, Ltd.; 2009.
	3. Greg Banish, “OBD-I & OBD-II A Complete Guide to Diagnosis, Repair & Emissions Compliance, CarTech Incorporated Publishers, ISBN:9781613257524, 2023.	6. James Halderman, “Automotive Technology: Principles, Diagnosis, and Service”, Pearson Automotive Series, 2019.
		7. Bosch Automotive Handbook, 10th Edition, 2018.

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	15%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	5%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Kiran, Volvo Engineer	1. Dr.M.Meenakshi, Professor, Department of ECE, College of Engineering Guindy, Anna University, Chennai	Dr.P.Vijayakumar SRMIST
-	-	Dr.S.Bashyam, SRMIST

Course Code	21IPE503T	Course Name	EMBEDDED SYSTEMS FOR E-MOBILITY	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards	NA		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	discuss the applications of 32-bit automotive
CLR-2:	explore the types of multicores applicable for E-mobility
CLR-3:	understand the embedded system mechanism in automotive
CLR-4:	discuss the various automotive embedded rapid prototyping and automotive networking protocols
CLR-5:	analyze the security risk in embedded system

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	explore the applications of 32-bit automotive	3	2	
CO-2:	understand the concepts of multicores for E-mobility	3	2	
CO-3:	discuss the embedded systems model applicable in automotive	3	2	
CO-4:	analyze the various embedded prototype model and networking protocols		2	3
CO-5:	discuss the guidelines of ISO26262 standard and security in embedded system		2	3

Module-1 – Automotive 32 bit applications	7 Hour
Choosing MCU's for Automotive Applications, Atmel — SMART ARM based MCU, ST- SPC5 32-bit Automotive MCU, NXP -Automotive MCU, Automotive microcontrollers for Electric Powertrain Control, Analog and digital interface.	
Module-2 -: Multicores for E-mobility	9 Hour
Overview of Single core processor Architecture and its limitations, Architectural Innovations, Need for Multi-core Processor and its Limitations, Classification Multicores, Multicore system software stack, GPUs as Parallel computers — architecture of a modern GPU, Overview of real-time operating systems and their role in embedded systems development. Understand concepts like task scheduling, synchronization, and memory protection.	
Module-3 – Embedded Systems in Automotive	8 Hour
The concepts of ECU design for automotive applications, Need for ECUs, advances in ECUs for automotive (Zonal Control unit), design complexities of ECUs, V-Model for Automotive ECU's Architecture, Characteristic features, Introduction to AUTOSAR — Types- Characteristic features. On Board communication: SPI, I2C, UART ECU Supervision mechanisms : Watchdog ADC, DAC, GPIO (High & Low Side drivers, H-Bridge), I/O Diagnostics.	
Module-4 – Automotive Embedded rapid Prototyping and Automotive Networking protocols	11 Hour
Introduction, Verification and validation, Model in Loop (MIL), Software in loop (SIL), Processor in Loop (PIL), Hardware in loop (HIL), Testing and simulation of embedded system through Speed goat and D-Space real time target machine, Testing methodologies for embedded systems, Debugging techniques and tools with industry standard (Eg: JTAG based), Overview of CAN —fundamentals —Message transfer —frame types-Error handling —fault confinement-Bit time requirements, Introduction to LIN and Flexray, MOST- Introduction to Network diagnostic tools (CANalyzer, CANape, CAPL Programming). Basics of CCP & XCP Ethernet or Automotive Ethernet Wireless communication protocols : WiFi, BLE, NFC Basics of Automotive Diagnostics	
Module-5 – Introduction to ISO26262 standard and security in Embedded system	10 Hour

Product Development System Level-Product Development Hardware Level-Product Development Software Level-Production and Operation-Supporting Processes-ASIL Oriented and Safety Oriented Analysis-Guidelines on ISO26262 (Informative)-Case Studies to illustrate concepts, Hazard analysis and Risk Assessment-Safety Goals, Preliminary Architecture-Functional Safety Concept. SW Quality: Standards like MISRC, SW Complexity, Overview on the Security Mechanism used in Automotive: RSA, Hashing. Secure Boot, SecOC, HSM. Memory Error handling: RAM & ROM Checks, ECC, Pre-Processing, Compilation, Linker Scripts, Make file, Understanding .elf & .map file, Writing the Linker and make scripts. Overview on Boot SW, SW Download

Learning Resources	1. Kathires, M., G. R. Kanagachidambaresan, and Sheldon S. Williamson. <i>E Mobility</i> . Springer International Publishing, 2022.	5. Barkalov, Alexander, Larisa Titarenko, and Magorzata Mazurkiewicz. <i>Foundations of embedded systems</i> . Vol. 195. Cham, Switzerland: Springer International Publishing, 2019.
	2. Kathires, M., and R. Neelaveni. <i>Automotive Embedded Systems</i> . Springer International Publishing, 2021.	6. Zurawski, Richard. <i>Embedded Systems Handbook: Embedded systems design and verification</i> . CRC press, 2018.
	3. Navet, Nicolas, and Fra nçoise Simonot-Lion, eds. <i>Automotive embedded systems handbook</i> . CRC press, 2017.	7. Wang, Jiacun. <i>Real-time embedded systems</i> . John Wiley & Sons, 2017.
	4. Marwedel, Peter. <i>Embedded system design: embedded systems foundations of cyber-physical systems, and the internet of things</i> . Springer Nature, 2021.	8. "Programming Embedded Systems: With C and GNU Development Tools" by Michael Barr and Anthony Massa

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	15%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	05%	-	-	-
Level 6	Create	-	-	05%	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Volvo Team	1. Dr.M.Meenakshi, Professor, Department of ECE, College of Engineering Guindy, Anna University, Chennai, Tamilnadu.	1. Dr.Padmajothi V, SRMIST
-	-	2. Dr.S.Bashyam, SRMIST

Course Code	21IPE504T	Course Name	VIRTUAL REALITY	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards	NA		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	explore the concepts of augmented reality and virtual reality.
CLR-2:	analyze unity 3D models and unreal engine
CLR-3:	explore the process of extended reality systems
CLR-4:	analyze use cases of AR-VR-MR-XR

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	comprehend the principles of augmented reality and virtual reality	3	2	
CO-2:	express unity3D models in software platform	3	2	
CO-3:	explore the process of extended reality systems	3	2	
CO-4:	discuss use cases of AR-VR-MR-XR		2	3

Module-1 - Introduction to AR/VR/MR/XR	10 Hour
Augmented Reality, Virtual reality, Mixed Reality, Extended reality, Market Analysis, Hardware, and Software Integrated Development Environment IDE, VR and AR Devices, Non-Fungible Token, Internet of Things, AI/ML, Perception, Temporal Resolution, Spatial Resolution, Motion Perception, Depth Perception, Colour Perception, Auditory, Perception, Haptics Perception, Locomotion Interfaces, Overview of VR Technology Applications in the Automotive industry, History and Evolution of VR in Automotive, 3D modelling and Visualization of Vehicle Designs in VR, Simulation and Testing of Vehicle Prototypes in VR	
Module-2 -: Unity 3D and Unreal Engine	12 Hour
Virtual Driving Simulations for Driver Education and Autonomous Vehicle Testing, VR For Manufacturing Process Visualization And Optimization, Advancements in VR Hardware and Software for Automotive Applications, Challenges and Considerations in Deploying VR In The Automotive Industry, 3D Modelling and Asset Creation for Automotive VR Experiences, Implementing Physics-Based Simulations And Interactions in Automotive VR, Editor, Game Objects and Components, Materials, Texturing, Basics Lighting, Skybox, Package Import and Export, Modelling, Scripting, Probuilder Modelling, Terrain Creation, Introduction to Asset Store, Avatar Creation, Animator, Particle Systems, C# Scripting, AR Development Platform – Vuforia with Unity, AR Deployments using ARKit, Workflow for Unreal Engine, Asset Libraries, Import functions, Plug-in Connection, Blueprint Workflows, Lighting and Shading, VRed (Guest Lecture, Co – Teaching with Volvo). Case study: Remote assistance for repair technicians, 3D visualization of vehicle components for easier repairs	
Module-3 - Extended Reality	12 Hour
XR Tool Kit Setup, Assembly Smart Factory, Locomotion Move Turn, Conveyor System, Animation, Teleoperation, UI Interaction, XR Challenges: XR Best Methods and Process, HMD Oculus, UX Design, Quality Testing of XR Systems, XR Deployment Platform – Oculus / SteamVR / Open XR Deployment Platform Workflows –Test Cases from Volvo Group as Capstone or Sample Programs. Case studies: Understanding augmented reality dashboards.	
Module-4 - AR-VR-MR-XR use cases	11 Hour
Overview of Use Cases in Industry 4.0, Blockchain, Medical Robotics, Military and Defense, Automobile Industry, Architecture Engineering, and Construction, Education, Manufacturing Industry, Health Care Industry, Cabin Design Analysis: Visibility and Reachability Analysis, Lighting and Shading Analysis, Ergonomics of Driver Through VR, Driver Behaviour Analysis through VR, Measure Distance through MR (HoloLens), Mobile App Development for Manufacturing Industry through AR Kit- Case study: Quality control and defect detection in manufacturing, Using VR for training assembly line workers, Pre-manufacturing design and approval.	

Learning Resources	1. Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung, <i>Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR)</i>, Springer, 2022 2. Steve Aukstakalnis, <i>Practical Augmented Reality A Guide to the Technologies, Applications, and Human Factors for AR and VR</i>, Addison Wesley, 20163. Kipper, Gregory, and Joseph Rampolla, <i>Augmented reality: An emerging technology guide to AR.</i>, Elsevier, 2012. 3. Glover, J., & Linowes, J. (2019). <i>Complete Virtual Reality and Augmented Reality Development with Unity: Leverage the power of Unity and become a pro at creating mixed reality applications</i>. Packt Publishing Ltd.	4. Linowes, J. (2020). <i>Unity 2020 virtual reality projects: Learn VR development by building immersive applications and games with Unity 2019.4 and later versions</i>. Packt Publishing Ltd. 5. Mack, K., & Ruud, R. (2019). <i>Unreal Engine 4 virtual reality projects: build immersive, real-world VR applications using UE4, C++, and unreal blueprints</i>. Packt Publishing Ltd.
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	15%	-	25%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	05%	-	-	-
Level 6	Create	-	-	05%	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Antariksh, Volvo Engineer	1. Dr.M.Meenakshi, Professor, Department of ECE, College of Engineering Guindy, Anna University, Chennai, Tamilnadu.	1.Dr.P.Vijayakumar SRMIST
-	-	2.Dr.S.Bashyam, SRMIST

Course Code	21ASE600T	21AUE600T	21BME600T	Course Name	JOURNAL PUBLICATION	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
	21BTE600T	21CEE600T	21CHE600T									
	21CSE600T	21FPE600T	21GEE600T									
	21ECE600T	21EEE600T	21EIE600T						0	0	0	3
	21MEE600T	21MHE600T	21NTE600T									

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	All	Data Book / Codes / Standards			Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	<i>motivate the students to get involved in a high quality research</i>
CLR-2:	<i>identify and be the expert in the latest development in a domain</i>
CLR-3:	<i>prepare and publish the technical article in a reputed journal</i>

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	<i>prepare a quality technical report related to their research findings</i>		3	
CO-2:	<i>update their domain knowledge at the front line of the area.</i>		3	
CO-3:	<i>recognize and validate their research by signifying that it meets certain quality standards</i>		3	
CO-4:	<i>communicate the outcome of the research in a professional way to the society</i>		3	

Learners attached themselves with a faculty from the beginning of the academic programme, involve in research work relevant to their area of specialization and publish an article at the end of second semester or beginning of third semester, the work can be considered equivalent to three credits.

- The journal paper must have been published before the course registration during the third semester.
- If the journal paper is just accepted but not published before the course registration, then he/she has to enroll an Professional elective course in third semester in addition to Journal Publication. If it is published at the end of the third semester, the enrolled elective course shall be dropped and the credit will be awarded for the published journal paper.
- The paper must have been published in a high-quality refereed SCI/SCIE/Scopus indexed journal.
- The paper should have the student as first author followed by mentor or faculty as second author.
- The department will form an evaluation committee consisting of domain experts and verify whether the published journal is good enough for the award of three credits.
- If it is worthy, then the committee shall evaluate the paper based on the quality (Quartile/ Impact Factor) of the journal and award the mark on the scale of 0-100.
- It is a one-time evaluation process; there is no need for any presentation by the student or weekly/monthly reviews.
- If the student submits the journal paper for the evaluation, then 100% attendance may be given. If he/she fails to submit the journal for the evaluation, marked as Absent, will be treated as an arrear, and he has to register for one Professional Elective course during the fourth semester in addition to his project work.
- If the journal paper is published during the fourth semesters, it will not be considered for the award of credits.

Quartile	Mark Awarded
Q1	91-100
Q2	71-90
Q3	56-70
Q4	50-55
No quartile/Not SCI	0

ACADEMIC CURRICULA

Open Elective Courses

Regulations 2021



SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

**Kattankulathur, Chengalpattu District 603203, Tamil Nadu,
India**

Course Code	21CHO601T	Course Name	SMART WASTE MANAGEMENT	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemical Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the need to replace the conventional waste management practices
CLR-2:	familiarize the smart ways to handle the waste
CLR-3:	expose the smart city ideas and the energy production opportunities from waste
CLR-4:	understand the application of computing in waste management
CLR-5:	familiarize the role of waste management assessments

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	realize the importance of implementing smartness in the waste management practices	3		
CO-2:	explore the opportunities to apply smart systems in waste collection, sorting, recycling	3		2
CO-3:	identify the energy generation ways from waste	3		3
CO-4:	examine the various technologies used in smart waste management	3		2
CO-5:	correlate the impact of smart waste management on environment	3		3

Module-1 - Introduction to Waste Management	9 Hour
Definition and types of waste (gaseous, liquid, solids), Overview of waste management principles-4R's, Significance of waste management, Challenges in traditional waste management practices, Environmental and social impacts of improper waste management, and Importance of smart waste management in modern society. Need for smart waste management, resource conservation.	
Module-2 -: Smart Waste Collection, Sorting and Recycling Systems	9 Hour
Automated waste collection systems and sorting technologies, Integration of GPS and GIS technologies, Cost-effectiveness and environmental benefits of smart collection systems, Optimization techniques for waste collection routes, Fleet management and vehicle tracking systems, Material recovery facilities, Advances in recycling techniques, Case studies on successful recycling initiatives. Liquids: collection- transportation (monitoring) / treatment – integrated vs distributed.	
Module-3 - Value Recovery	9 Hour
Introduction to waste-to-energy conversion, anaerobic digestion and biogas production, Incineration and gasification technologies, Principles of composting and Organic Waste Management. Recovery of valuables such as metals, chemicals, from aqueous streams and struvite from domestic sewage etc.	
Module-4 - Smart Cities and Smart Technologies in Waste Management	9 Hour
Introduction to smart cities and their components, Role of smart waste management in smart city development, Government policies and regulations promoting smart waste management. Introduction to IoT, data analytics, machine learning and sensor technologies for waste monitoring and sorting, RFID and GPS technologies for waste tracking and monitoring, Remote monitoring and Real-time monitoring systems and data collection platforms, Application of sensors in waste bins and containers, Case studies showcasing IoT implementations in wastewater management.	
Module-5- Sustainability, Circular Economy and Future Aspects in SWM	9 Hour
Role of SWM in sustainable development, SDGs, Life cycle assessment (LCA), Carbon footprint analysis, Environmental impact assessment, Principles of the circular economy, Analysis of successful SWM projects, Role of individuals, society and government in promoting SWM, Challenges and opportunities for innovation in implementation. Case studies: Indore, Varanasi.	

Learning Resources	1. John Pichtel, "Waste Management Practices: Municipal, Hazardous, and Industrial", "CRC Press", II Edition, 2024 2. W. Ejaz, A. Anbalagan, "Internet of Things for Smart Cities: Technologies, Big Data and Security", "Springer", I Edition, 2018.. 3. K.Sasikumar, Sanoop Gopi Krishna, "Solid waste management", "PHI Learning Ltd". 2009, 4. S.C.Bhatia, "Environmental pollution and control in chemical process industries," "Khanna Publishers"2001.. 4. S.C.Bhatia, "Wealth from waste", "Atlantic Publishers", 2007, 5. Paul L. Bishop, "Pollution prevention: fundamentals and practice", "Waveland Pr Inc. Publishers", 2004. 6. A. Biswaranjan, S.Dey, M.Zidan, "IoT-Based Smart Waste Management for Environmental Sustainability (Smart and Intelligent Computing in Engineering)", "I Edition", CRC Press, 2022 7. John Doe, "Smart Waste Management: Methods, Technologies, and Applications"	Internet Sources 1. https://www.link-labs.com/ 2. https://www.infosys.com/industries/waste-management/industry-offerings/smart-collection-disposal.html 3. https://www.greencitytimes.com/5-modern-waste-management-technologies/ 4. https://solarimpulse.com/waste-management-solutions Research Articles 1. A Review on Smart Waste Collection and Disposal System, doi:10.1088/1742-6596/1969/1/012029 2. Modern Technologies for Waste Management: A Review, doi.org/10.3390/app13158847 3. 25 - Smart waste management practices in smart cities: Current trends and future perspectives, doi.org/10.1016/B978-0-323-85792-5.00011-3
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	30%	-	-	-	20%	-
Level 2	Understand	30%	-	30%	-	20%	-
Level 3	Apply	40%	-	30%	-	20%	-
Level 4	Analyze	-	-	40%	-	20%	-
Level 5	Evaluate	-	-	-	-	20%	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd, Chennai	1. Dr. Lima Rose Miranda, Anna University, Chennai	1. Dr. K. Suresh, SRMIST
2. Mr. S. Stalin, Course Director, Chem Skill Development Centre, Chennai	2. Dr. N. Anantharaman, Former Professor, NIT Trichy	2. Dr. S. Sam David, SRMIST

Course Code	21CE0533T	Course Name	SMART CITIES	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the concept of smart city and associated challenges.
CLR-2:	provide latest technologies used in intelligent building.
CLR-3:	understand process of planning and drafting a plan for smart city.
CLR-4:	understand the importance of different smart system.
CLR-5:	establish the importance of green building in smart system.

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	acquire knowledge on concept of smart city	2	2	3
CO-2:	acquire knowledge on smart cities planning and development	2	1	3
CO-3:	apply the developing process of smart cities.	3	2	2
CO-4:	apply the different smart system concepts	2	2	3
CO-5:	work out the most energy efficient technique in smart system	3	2	2

Module-1 - Introduction to Smart Cities	9 Hour
Introduction to city planning, Concept of smart city, Principal stakeholders, key trends in smart cities developments. Main components of smart city - Smart governance - Smart economy - Smart people - Smart services - Smart buildings- Smart infrastructure - Smart living. Smart transportation - Smart energy - GIS & GEO data - Introduction to smart city digital twin.	
Module-2 -: Smart Cities Planning and Development	9 Hour
Understanding smart cities, Dimension of smart cities, - Global experience of smart cities - Global standards and performance benchmarks, Practice codes - Soft and hard infrastructure of smart city - City wide network - Wireless networks - IoT and smart city - E-Government and smart city- Smart services- India "100 smart cities" policy and mission.	
Module-3 - Smart Cities Development	9 Hour
Smart city planning and development, Financing smart cities development, Governance of smart cities - Smart mobility analysis. Smart cities marco view and case studies- Smart cities macro (Chelsea Collier/Kijin Seung)- Smart cities & Robotics technologies (Huihai Wang)- Austin AI housing analysis- Financing smart cities development.	
Module-4 - Project Management in Smart Cities	9 Hour
Phases, Stages of project and work break down Structure, Project organization structure, Planning, Scheduling and CPM, Project cost analysis, resource allocation & levelling, Line of balancing technique, Project monitoring and control, Project risk management - Case Studies on PM of Smart Cities.	
Module-5- Green Building in Smart Cities	9 Hour
Introduction to green buildings, Rating system, Energy saving system. Energy demand- Green approach to meet energy demand - Index of Indian cities towards smartness – A statistical analysis- Alternative resources, Reliability on predictability scale, Solar options, PV and thermal; Singular or hybrid - Capacity limit for the indirect solar resources, Effectiveness in responsive environment in smart city; Smart communication using green resources. PV technology, PV of various scale for smart city applications, Energy efficiency, Policies of Solar PV in smart domains (RPO, REC, Carbon credit, etc.)- Drive green in Smart city, FEV, HEV, Application of Solar in mobility.	

Learning Resources	1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 1-85649-477-2) 2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3. Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024- 4. William J. V. Neill (2004); "Urban Planning and cultural identity"; Routledge, London (ISBN: 0-415-19747-3)	5. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); "Remaking the city: Social science perspective on urban design"; State University of New York Press, Albany (ISBN: 0-87395-678-8) 6. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science 7. "Draft Concept Note on Smart City Scheme". Government of India - Ministry of Urban Development (http://indiansmartcities.in/downloads/concept_note_3.12.2014_revised_and_latest.pdf)
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. G Muneeswaran, L&T, gmeswar@Intecc.com	1. Dr. Senthilkumar. V, IIT Palakkad, senthil@iitpkd.ac.in	1. Dr. N. Ganapathy Ramasamy, SRMIST
2. Dr. Senthilkumar. V, IIT Palakkad, senthil@iitpkd.ac.in	2. Dr. Ramesh Kannan. M, Anna University (CEG), rameshkannan@annauniv.edu	2. Dr. Gopinath S, SRMIST

Course Code	21CE0561T	Course Name	WASTE TO ENERGY	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand various types of waste generation and their characterization
CLR-2:	posses knowledge on the solid waste disposal
CLR-3:	understand the concepts of energy conversion using thermo- chemical and bio-chemical conversion
CLR-4:	evaluate various energy conversion techniques
CLR-5:	utilize the plastic and agricultural wastes for energy conversion

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	understanding the usage of solid waste for various purposes	2	2	2
CO-2:	analyse the disposal of solid waste after source reduction	2	2	2
CO-3:	apply energy conversion concepts for waste disposal/ reuse	2	2	2
CO-4:	understand and analyse the developments in waste to energy conversion techniques	2	2	2
CO-5:	impart the energy conversion techniques using plastic and agricultural wastes	2	2	2

Module-1 - Efficient Waste Management	9 Hour
Waste and Waste processing- Definitions, sources- Waste generation in a locality- Types and composition of various types of waste- Characterization of Municipal Solid Waste (MSW), Industrial waste and biomedical waste (BMW)- Waste collection and transportation- Waste processing- Size reduction and Separation- Waste management hierarchy- Waste minimization and recycling of MSW- Life Cycle Analysis(LCA), Material recovery facility (MRF)- Rules related to the handling, treatment and disposal of MSW and BMW in India	
Module-2 -: Disposal Methods	9 Hour
Composting- Composting management and Leachate- Incineration- Types of Incineration- Landfill- Landfills leachate- composition, characteristic, movement- Environmental Monitoring system for landfill gas- Case studies on various methods of disposal adopted in India.	
Module-3 - Advanced Waste Treatment Technologies	9 Hour
Pyrolysis-Gasification of waste -Briquetting- Syngas utilization- Environmental monitoring system thermo-chemical process- Centralized and decentralized energy production- Environment and health impacts of incineration- Measures taken to reduce the impact of incineration- Case studies on all treatment technologies.	
Module-4 - Renewable Energy from Waste	9 Hour
Refuse derived fuel (RDF)- Biogas methane generation- Alternate fuel resource (AFR)- Design of waste to energy plants for cities- Anaerobic digestion, Direct combustion- Location and siting for waste to energy plants- Environmental and health impacts of waste to energy conversion- Case studies on all renewable energy from waste.	
Module-5- Innovative Waste Transformation	9 Hour

Densification of solid waste- Energy production from waste plastics- Introduction to micro biofuel cells-Fermentation and transesterification-Cultivation of algal biomass from wastewater and energy production from algae- Recycling of e-waste- Waste to energy- potentials and constraints in India- Eco-technological alternatives in waste processing- Recent trends and future scenario- Case studies on all innovative waste transformation.

Learning Resources	1. Gary C. Young, <i>Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons</i> , John Wiley & Sons, 2020	4. Parker, Colin, & Roberts, <i>Energy from Waste - An Evaluation of Conversion Technologies</i> , Elsevier, 1985
	2. Velma I. Grover & Vaneeta Grover, <i>Recovering Energy from Waste Various Aspects</i> , 2002	5. Shah, Kanti L., <i>Basics of Solid & Hazardous Waste Management Technology</i> , Prentice Hall, 2000
	3. Robert Green, <i>From Waste to Energy</i> , Cherry Lake Pub, 2019	6. NPTEL- <i>Waste to Energy Conversion</i>

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr. Suyash Misra, Arcadis, Bangalore, suyash.misra@gmail.com	1.Mr. Suyash Misra, Arcadis, Bangalore, suyash.misra@gmail.com	1.Dr. P. Purushothaman, SRMIST
2. Dr. Harish Gupta, Osmania University, Hyderabad, harishgupta78@gmail.com	2. Dr. Harish Gupta, Osmania University, Hyderabad, harishgupta78@gmail.com	2.Dr. K. Prasanna, SRMIST

Course Code	21CE0632T	Course Name	GIS AND ITS APPLICATIONS	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Learn the basic concepts of GIS
CLR-2:	Understand the data structure in GIS
CLR-3:	Learn the vector and raster analysis in GIS
CLR-4:	Study the interpolation techniques and modeling in GIS

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	Understand the concepts and data representation of geospatial data	2	1	2
CO-2:	Learn how data are stored in GIS	1	1	3
CO-3:	Perform the operation with vector and raster data	1	2	3
CO-4:	Carry out various applications in GIS	2	2	2

Module-1 -GIS Concepts	11 Hour
GIS introduction, components, Datum, Coordinate system, Projection, Maps-types, Data Types- Spatial, non-spatial data, Data formats- Vector data and raster data format, Data quality, Data accuracy, Data standards, Topology, Data sources, Input methods, output methods.	
Module-2 -:Data Structure	12 Hour
Vector data model – Georelational model – Coverage data model – Shape file , Object based vector data model - Geodatabase, Raster data model, Raster data structure, Data conversion	
Module-3 - GIS Data Analysis	12 Hour
Data Retrieval, Query, Reclassification, Proximity Analysis – Overlay,– Raster operations. Interpolation, Modelling.	
Module-4 - GIS Applications	10 Hour
Multi-criteria analysis – Applications related to disaster, Water resources, Urban planning, Change detection, Suitability mapping	

Learning Resources	1. Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, 5th Edition, Eider Press, Minnesota 2016.	4. Anji Reddy .M, Textbook of Remote Sensing and Geographical Information Systems, BS Publications, Hyderabad. 2011.
	2. Kang Tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 9th edition, 2019.	5. Rolf A. de, Principles of Geographic Information Systems An introductory textbook, The International Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands, 2001.
	3. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Science & Systems, Fourth Edition, John Wiley & Sons, Inc., 2015.	6. Michael N. DeMers, Fundamentals of Geographic Information Systems, 2008.
		7. https://nptel.ac.in/courses/105107155/

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	10%	-	10%	-	10%	-
Level 6	Create	10%	-	10%	-	10%	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Tune Usha, Scientist, NCCR, Chennai	1. Dr. C. Lakshumanan, Professor, Bharathidasan University	1. Dr. Aparna S. Bhaskar, SRMIST
2. Dr V. S. Jayakanthan, Scientist, NIH, Andra Pradesh	2. Dr. Rajesh Raghunath, Professor, University of Kerala	2. Dr. Karuppasamy Sudalaimuthu, SRMIST

Course Code	21CS0621T	Course Name	CYBER SECURITY	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	School of Computing	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the cyber security threat landscape
CLR-2:	develop a deeper understanding and familiarity with various types of cyber attacks
CLR-3:	analyze and evaluate existing legal framework and laws on cyber security
CLR-4:	analyze and evaluate the digital payment system security and remedial measures against digital payment frauds
CLR-5:	analyze and evaluate the importance of personal data its privacy and security

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	identify security issues and resolve	1		2
CO-2:	work with cybersecurity tools	2		
CO-3:	analyze threats and risks within context of the cyber security architecture	3		
CO-4:	appraise cyber security incidents to apply appropriate response		3	
CO-5:	evaluate decision making outcomes of cyber security scenarios		3	3

Module-1 - Overview of Cyber security	9 Hour
Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies	
Module-2 – Cyber crimes	9 Hour
Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smashing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Crypto jacking, Dark net- illegal trades, drug tracking, human tracking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake news cybercrime against persons - cyber grooming, child pornography, cyber talking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.	
Module-3 - Cyber Law	9 Hour
Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and social media, Cyber Laws of other countries, Case Studies.	
Module-4 - Data Privacy and Data Security	9 Hour
Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations (GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., social media- data privacy and security issues	
Module-5 – Cyber security Management, Compliance and Governance	9 Hour

Cyber security Plan- cyber security policy, cyber crises management plan, Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

Learning Resources	1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. 2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley. 3. Security in the Digital Age: Social Media Security Treats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.	4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press. 5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication. 6. Auditing IT Infrastructures for Compliance by Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	20%	-	25%	-
Level 3	Apply	30%	-	25%	-	30%	-
Level 4	Analyze	30%	-	25%	-	30%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Karthik Expert Member from k7 Computing	Dr. Bhawana Rudra Professor, National Institute of Technology, Warangal	1. Dr. M.B Mukesh Krishnan, SRMIST
		2. Dr. V. JosephRaymond, SRMIST

Course Code	21ECO550T	Course Name	APPLIED MACHINE LEARNING IN IMAGING SYSTEMS	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	introduce the fundamentals of imaging systems and machine learning
CLR-2:	get familiar with the concepts of image preprocessing and feature extraction
CLR-3:	explain the need of machine learning models for image processing
CLR-4:	acquire knowledge on various models used for object detection and localization
CLR-5:	utilize the concepts of machine learning applied to imaging systems.

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	gain knowledge on the fundamentals of digital image processing and machine learning	3	-	1
CO-2:	interpret preprocessing and feature extraction methods on digital images	3	-	1
CO-3:	inspect the use of machine learning models for the processing of digital images	3	-	2
CO-4:	analyze the various object detection and localization models	3	-	2
CO-5:	develop and implement machine learning solutions for various imaging problems	-	3	3

Module-1 - Introduction to Imaging Systems and Machine Learning	9 Hour
Introduction to Imaging Systems: Fundamentals of digital imaging, Image acquisition and representation, Common imaging systems and their applications. Overview of Machine Learning: Basics of machine learning, Types of machine learning algorithms and models - supervised, unsupervised, reinforcement learning.	
Module-2 - Image Preprocessing and Feature Extraction	9 Hour
Image Preprocessing Techniques: Noise reduction, Contrast enhancement, Image normalization and scaling. Feature Extraction: Edge detection, Texture analysis, Color and shape features. Dimensionality Reduction: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and t-distributed Stochastic Neighbor Embedding (t-SNE).	
Module-3 - Machine Learning Models for Image Processing	9 Hour
Supervised Learning for Image Classification: Decision trees, random forests, and support vector machines, K-nearest neighbors and logistic regression. Performance metrics and evaluation. Unsupervised Learning for Image Segmentation: Clustering techniques (K-means, hierarchical clustering), Gaussian Mixture Models (GMM), Evaluation of segmentation results.	
Module-4 - Models for Object Detection and Localization	9 Hour
Deep Learning: Introduction to neural networks, Convolutional Neural Networks (CNNs) for image recognition, Transfer learning and pre-trained models. Object Detection and Localization: YOLO (You Only Look Once), R-CNN (Region-based Convolutional Neural Networks), SSD (Single Shot MultiBox Detector). Generative Models and Image Synthesis: Generative Adversarial Networks (GANs).	
Module-5 - Case Studies and Practical Applications	9 Hour
Medical Imaging: Machine learning in radiology and pathology, Case studies in medical image analysis; Remote Sensing and Satellite Imaging: Applications in environmental monitoring and agriculture Techniques for processing satellite imagery; Project Development: Project proposal and planning, Implementation of machine learning solutions in imaging systems.	

Learning Resources	1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing"- 4th Edition, Pearson Education 2018.	4. Christopher M. Bishop, "Pattern Recognition and Machine Learning" by, Springer, August 2006.
	2. Simon O. Haykin, "Neural Network and Learning Machines", 3rd ed., Pearson Education, 2009.	5. Jeff Proise, "Applied Machine Learning and AI for Engineers", O'Reilly Media, Inc., November 2022.
	3. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision with Mind Tap", 3rd Ed, 2008, Thomson Learning.	

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	15%	-	15%	-	15%	-
Level 2	Understand	25%	-	20%	-	25%	-
Level 3	Apply	30%	-	25%	-	30%	-
Level 4	Analyze	30%	-	25%	-	30%	-
Level 5	Evaluate	-	-	10%	-	-	-
Level 6	Create	-	-	5%	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Kartik Soundarrajan, Vice President, Quadgen Wireless Solution Pvt. Ltd., Bangalore.	1. Dr. M. Meenakshi, College of Engineering, Guindy.	1. Dr. S. Dhanalakshmi, SRMIST
2. Mr. George Jacob, CEO and Founding member, Semicon Design Technologies, Bangalore		2. Dr. M. Sangeetha, SRMIST

Course Code	21EE0601T	Course Name	ELECTRIC VEHICLE TECHNOLOGY	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electrical and Electronics Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	provide an overview of the electric vehicle architecture classes, configuration, and components
CLR-2:	acquire knowledge about the different energy storage systems in electric vehicles
CLR-3:	enrich the knowledge of electric motor drives and their control techniques
CLR-4:	acquaint the electric vehicle charging systems
CLR-5:	identify the electric vehicles battery management, energy management system and control units

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	illustrate the various parts of the electric vehicle and their functions	1	2	2
CO-2:	acquire knowledge of various energy storage systems used in electric vehicle	2	3	3
CO-3:	illustrate the technical aspects of electric vehicle traction motors and their control techniques.	3	3	3
CO-4:	comprehending electric vehicle charging systems, regulation and adoptions	2	1	3
CO-5:	analyze the battery and energy management systems, and control units technologies used in electric vehicle	2	3	3

Module-1 - Electric Vehicle Architecture	9 Hour
Introduction to Hybrid Electric Vehicle (HEV), Plugged in Electric Vehicle (PEV), Comparison of HEV, PEV with ICE based Vehicle, Powertrain Architectures of HEV, PEV and Fuel Cell, Framework of EV powertrain requirements, PEV components and systems, Introduction of Driving Cycle, Vehicle Dynamics of EV, Power Curve, Transmission losses and efficiency, Vehicle Dynamic and Power calculation of EV, Review on EV market.	
Module-2 - Energy Storage Systems in Electric Vehicle	9 Hour
Performance criteria for Electric vehicles batteries, Power and energy requirements of batteries - Introduction to lithium-ion battery: Components, functions, advantages, and disadvantages of lithium-ion batteries, Types of the lithium-ion battery: Lithium Iron Phosphate Battery (LFP), Lithium Nickel Manganese Cobalt Oxide (LNMC), Lithium iron phosphate battery (LiFePO ₄), and lithium polymer, Supper and Ultra Capacitors, Battery parameters estimation, Battery Specifications and characteristics, Heat generation, Battery design, Battery operating and performance parameters, Charge-discharge characteristics of batteries, Measurement of current, voltage and temperature, Case Study and Problems in battery pack assembly and testing, Case Study on Battery charging and discharging characterizations	
Module-3 - Traction Motors and Control Techniques	9 Hour
Introduction to EV Motor drive train and Selection of traction Motor, Dynamics of Electric drives – Classes of Power train motor configurations and components - Power Electronics Converters System in drive train: Power Converters, PWM control techniques, Selection of Switch, Passive Elements, Wire harvesting – Type of Motor drive: BLDC, PMSM: radial-flux and axial-flux and SRM Motor drives - Control of techniques for EV drive motors - Electrical Barking- Case Study and Problems in EV Motor Drives, Case Study on FOC for PMSM and it is Traction Drive Characteristics	
Module-4 -Electric Vehicle Charging System	9 Hour
Components of EV battery chargers, Types of EV Charging, standards, schematic diagram operation, and Standards: Onboard, Off the board, AC, DC, Fast, Flash charging, National standards for EV technology in India, global standards Regional Specific Plug types (J1772, CHAdeMO, CCS2, GB/T, Tesla) Parameters and connectors, Plugs, and Communications, Inductive and Capacitive Wireless charging, V2G, V2V connectivity, interfaces V2G communication, Policy formulation and implementation at various levels of government, Case Study on CCS charger and its charging characteristics.	
Module-5 - Battery Management, Energy Management Systems and Control Units	9 Hour

Battery management system: Active BMS, Passive BMS, and Smart BMS, Battery charging technologies: CC, CV, CCCV, Basics of BMS, Concepts SOC/SOH, DoD, Cell balancing, Protection features Over voltage/over current/ over temperature, Charging/discharging rates, Thermal Runway: High discharge rates, short circuits, charging and discharging, Environment and Human Health impact assessments of batteries, Energy management system for HEV and Hydrogen Fuel Cell EV, Electronic control unit (ECU), vehicle control unit (VCU), ABS brake System, Anti-lock braking system and control system design, Adaptive cruise control (ACC), Overview of automotive communication protocols: CAN, LIN, Flex Ray, Case Study on Simulation of Battery Management Systems

Learning Resources	1. Electric and Hybrid-Electric Vehicles: Fuel Cell Hybrid EVs - Ronald Jurgen - SAE, 2011. 2. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, first edition, CRC Press, 2009 3. Wu, Yuping, Lithium-ion Batteries Fundamentals and Applications, first edition, CRC Press, Taylor and Francis, 2015. 4. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi Taylor & amp, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles; Francis Group, LLC, Second Edition, 2018. 5. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley and Sons Ltd, second edition, 2012	6. Shuiwen Shen , Qiong-zhong Chen, Practical Control of Electric Machines for EV/HEVs Design, Analysis, and Implementation, Springer, first edition, September 2023 7. William.B.Ribbens , Understanding Automotive Electronics, eight edition Butterworth-Heinemann publications, 2017.. 8. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, Fifth edition, John Wiley & amp; Sons Inc., 2007. 9. Thandavarayan Maiyalagan, Perumal Elumalai, Chokkalingam Bharatiraja, Rechargeable Lithium-Ion Batteries Trends and Progress in Electric Vehicles, CRC Press, Taylor and Francis, first edition, 2020

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	10%	-	20%	-
Level 2	Understand	30%	-	30%	-	30%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	20%	-	30%	-	20%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Haricharan Radhakrishnan, Powertrain, Volvo Group	1. Dr. Deepak Ronanki, IITM	1. Dr. C.Bharatiraja, , SRMIST
2. Dr.Kanakasabapathi Subramanian, Ashok Leyland	2. Dr. Sheldon Williamson, University of Ontario	2. Dr. K.Vijayakumar, SRMIST

Course Code	21ME0501T	Course Name	INDUSTRIAL SAFETY	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the causation and prevention approaches of accident
CLR-2:	familiarize with the concept of various industrial hazards
CLR-3:	comprehend the aspects of safety in an industrial operation
CLR-4:	acquire efficient knowledge on the concept of fire prevention and control
CLR-5:	familiarize with the regulations for health, safety and environment

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	categorize the accident theories and its predominant safety factors			3
CO-2:	classify the industrial hazards and its associated risk		3	
CO-3:	portray the safety consideration in an industrial operation to conduct risk assessment in material handling process	3		
CO-4:	perform the fire prevention strategies and assessments in an industrial setting		3	
CO-5:	identify the various regulations, acts and rules in terms of health, safety and environment			3

Module-1 - Principles of Safety Management	9 Hour
Concept of an accident, reportable and non-reportable accidents, unsafe act and condition - contribution factor for accident – Theories and principles of accident causation - accidents - Accident reporting and investigations, Safety Performance Monitoring - Reactive and proactive monitoring techniques , Calculation of accident indices - Risk Assessment –Safety Education and Training - Importance of training- identification of training needs-training methods – training evaluation methods, Safety committees and their need, types and advantages	
Module-2 - Industrial Hazards	9 Hour
Physical Hazard – Noise, Vibration, Temperature and Radiation – measuring methods, standards and its impact – Chemical Hazard - recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases and its concentration - Exposure vs. Dose, TLV - Methods of Evaluation- Material Safety Data Sheet- Biological Hazard - classification of Bio-hazardous agents –bacterial agents, fungal, parasitic agents, infectious diseases -Biohazard control program- Mechanical Hazards – Psychological Hazards – Ergonomics and its concept.	
Module-3 - Safety in Industrial Operation and Design	9 Hour
General safety consideration in material handling– Working at Heights - Safe Access - Safe Use of Ladders and Scaffoldings - Fall Prevention & Fall Protection - Safety Belts - Safety nets - Work permit system – Maintenance Engineering – Types, Service life of the equipment, roles and responsibilities of the Maintenance Department; Concept of Periodic and Preventive Maintenance	
Module-4 -Fire Prevention and Control	9 Hour
Fire Safety Principles – Flash point, Fire point, ignition temperature, LFL, UFL, flame propagation; Fire extinction - stages and modes of fire, classes of fire – fire extinguishers and types-; Fire hydrants – Hoses, Fire Pipes and Pumps; Fire Sensors and Alarms; Fire drill and rescue operations; Safety color codes – OSHA and ANSI standards	
Module-5 - Regulations for Health, Safety and Environment	9 Hour
Factories act and rules - Workmen compensation act – Gas Cylinder rules – Environmental Pollution act – Bio-medical waste Management rules - Building and other construction act – Green Building Concept – Indian motor vehicle act and rules- Indian Petroleum act - The Aircraft Act and Rules.	

Learning Resources	1. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361] 2. Rieske, David W., Asfahl and C. Ray, "Industrial Safety and Health Management", 6th Edition, Prentice Hall Professional Technical Ref. 2009. 3. Heinrich.H.W, "Industrial Accident Prevention", McGraw-Hill, 1980. 4. Alexandrov.M.P, "Material Handling Equipment", Mir Publishers, Moscow, 1981. 5. Lees.F.P, Loss "Prevention in Process Industries", Butterworths, NewDelhi, 1986.	6. Canter.R.L, "Environmental Impact Assessment", (2nd Edition), McGraw Hill, 1996. 7. IS CODES: IS 5903, IS 807, IS 2760, IS 14469, IS 13367-1, IS 5324, IS 7167, IS 7155, IS 1800.1, IS 3521 of Oil Industry Safety Directorate, Govt. of India 8. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978- 9380386423 9. Moore, T. "Handbook of Disaster and Emergency Management: Principles and Practice" (2016).

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Rajkumar, Cluster EHS Manager (South), L&T Construction, PVT. LTD.	1. Dr S.Kalaiselvam, Professor, Anna University	1. Dr Vignesh K.S, SRM IST
2. Mr. Karthik Rajan. Lead EHS Specialist, Grundfos		

Course Code	21ME0502T	Course Name	ENTREPRENEURSHIP AND IPR	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	develop a foundational understanding of entrepreneurship, its functions, types, and its societal roles to instill a mindset for innovation and self-employment.
CLR-2:	gain a comprehensive overview of Intellectual Property Rights (IPR), including their need, global evolution, and relevance in the Indian context.
CLR-3:	understand the procedures and legal frameworks associated with patents and industrial design registrations both in India and internationally.
CLR-4:	analyze copyright, trademark, and domain name systems, including their usage, infringement issues, and digital implications.
CLR-5:	explore additional IP mechanisms such as geographical indications and trade secrets to appreciate their value in safeguarding traditional and industrial knowledge.

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	explain the fundamental principles of entrepreneurship and the entrepreneurial process.		3	
CO-2:	interpret the types, scope, and legal evolution of Intellectual Property Rights at national and international levels.		3	
CO-3:	apply the procedures for patent filing and industrial design registration in accordance with Indian and international norms.			3
CO-4:	analyze copyright and trademark regulations including ownership, infringement, and domain name disputes.			3
CO-5:	evaluate and interpret other forms of IP such as GI and trade secrets for their commercial and legal applications.		3	

Module-1 - Entrepreneurship and its concepts	9 Hour
Introduction to Entrepreneurship concepts, Types of entrepreneurs, Entrepreneurial process : Idea generation to commercialization, Social Responsibility of Entrepreneur, Entrepreneurial Training Methods Motivation and Decision making, Social Responsibility of Entrepreneur, , Business Model canvas and lean startup model, Overview of funding options: Venture capital, angel investors, crowdfunding, etc. Government and private support systems for entrepreneurs; Case studies: Stanford StartX, India's Startup India policy, Role of Technology and innovation in Entrepreneurship	
Module-2 - Introduction and overview of IPR	9 Hour
Introduction of IPR and need, Various kinds of IPR, Genetic Resources and Traditional Knowledge IPR in India, Genesis and Development – IPR in abroad, The way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations, National Treatment and Efficient Protection – Harmonization, Indian patent acts, New Developments in IPR, Comparative IPR laws: India, USA, EU	
Module-3 - Patents and Industrial designs Registrations	9 Hour
Inventions, Discovers and what do patent protect, Benchmark for patentability of inventions, How to apply for patents in India and other countries, Granting and opposing of a patent, Rights of a patent holder and validity, Licensing and using patent rights in the market, Innovations involving shapes and ornamentation of objects, Types of industrial Design registrations, Benchmark for granting of IDR and registrations	
Module-4 - Copyrights and Trademarks	9 Hour
Introduction to Copyrights and related rights, Implications of copyright in every life copyrightable works. Ownership of copyright, Licensing of copyright, Registration of copyrights, Infringement of copyrights, Civil remedies, Copyright societies, Rights of broadcasters and Performers, Fair use in copyright, Digital Copyright issues, Introduction to trademarks and different types, Classifications of Trademarks and domain names, Domain name selection, use and Issues related to domain names.	
Module-5 - Other forms of IP	9 Hour
Other forms of patents and examples, Geographical indications and examples in India, Importance of GI in promoting and preserving traditional knowledge, Practices for enhancing economic benefits, Documentation needed for GI registration, Definition of trade secret and examples, Trade secrets how industries are maintaining, How trade secrets to implement and use for businesses, Novelty of GI and trade secrets	

Learning Resources	1. Frederick H, O'Connor A, Kuratko DF. <i>Entrepreneurship: Theory, process, and practice</i>. Cengage Learning; 2016. 2. Reis E. <i>The lean startup</i>. New York: Crown Business. 2011;27:2016-20. 3. Ganguli P, Jabade S. <i>Nanotechnology intellectual property rights: research, design, and commercialization</i>. CRC Press; 2017 Dec 19. 4. Posey DA, Dutfield G. <i>Beyond intellectual property: toward traditional resource rights for indigenous peoples and local communities</i>. IDRC; 1996.	5. <i>The Indian Patents Act 1970 (as amended in 2005), The Indian Copyright Act 1950(as amended in 2012), Indian Trademarks Act 1999, The Indian Industrial Designs Act 2000.</i> 6. World Intellectual Property Organization. <i>Inventing the Future: An Introduction to Patents for Small and Medium-sized Enterprises</i>. World Intellectual Property Organization; 2018. 7. <i>The Intangible Advantage Understanding Intellectual Property In the New Economy</i>, by David Kappos, David Kline, The Michelson 20MM Foundation 2016
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. M Mohan Kumar, Dhakshanth Industries, Thiruvallur 2. Dr.S.Rajkumar, President Rane (Madras) Limited, Engine Components Division (ECD) 3. Dr. G. Saravanan, PhD., DNYT., PE., C Eng., FIITArb., India Strategy & Facility Manager Earthmoving Division Caterpillar India Private Limited, Thiruvallur	1. Dr. A S S Balan, Assistant Professor, NITK, Surathkal 2. Dr. M. Kanthababu, Professor, Anna University	1. Dr M Prakash, SRMIST 2. Dr. Abburi Lakshman Kumar, SRMIST

Course Code	21ME0505T	Course Name	ENERGY STORAGE SYSTEMS	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechanical Engineering	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the various types of energy storage Technologies.
CLR-2:	analyze thermal storage systems.
CLR-3:	analyze different battery energy storage technologies
CLR-4:	analyze the thermodynamics of hydrogen energy and Fuel Cell
CLR-5:	study the various applications of energy storage systems.

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	gain knowledge of various energy storage technologies and their need.	2	-	-
CO-2:	design a thermal storage system.	3	2	-
CO-3:	analyze battery storage system.	2	2	-
CO-4:	analyze the performance of the hydrogen and fuel cell.	2	-	-
CO-5:	gain knowledge of various applications of storage technologies	3	2	-

Module-1 - Needs for Energy Storage	9 Hour
Different forms of energy, Energy supply and demand, Energy availability, Necessity of energy storage, Types of energy storage, Comparison of energy storage systems and technologies – Applications.	
Module-2 - Thermal Energy Storage	9 Hour
Thermal energy storage, Sensible and latent heat storage, Simple water, pebble bed and rock bed storage system, Pressurized water storage system, Cold energy storage- Ice storage, Seasonal energy storage, Modeling of thermal storage units, Modelling of phase change storage system – Simple heat storage units, packed bed storage units, Modelling using porous medium approach.	
Module-3 - Electrical Energy Storage	9 Hour
Fundamental concept of batteries, Measuring of battery performance, Charging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead acid, Nickel – Cadmium, Zinc Manganese dioxide, Mathematical Modelling for Lead Acid Batteries, Flow Batteries, Electric double-layer capacitors (EDLCs) and pseudo capacitors. Lithium-ion batteries, Electric vehicles' battery thermal management.	
Module-4 - Hydrogen and fuel cells	9 Hour
Chemical energy storage, Fuel Cells, History of Fuel cell, Principles of Electrochemical storage and types, Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis, Fuel Cell Thermodynamics.	
Module-5 - Alternate Energy Storage Technologies	9 Hour
Mechanical energy storage-Flywheel, Supercapacitors - Principles, Methods and Applications, Compressed air Energy storage, Concept of Hybrid Storage and Applications, Pumped Hydro Storage and Applications.	

Learning Resources	1. Sukhatme and Nayak, <i>Solar Energy: Principles Of Thermal Collection & Storage</i> , Tata McGraw-Hill, 2008.	5. Ru-shiliu, Leizhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley, 2012.
	2. Ibrahim Dincer and Marc A Rosan, <i>Thermal Energy Storage: Systems & Applications</i> , John Wiley, 2006.	6. Ram Kunwer, <i>Thermal Energy Storage Systems for Concentrated Solar Power Applications</i> , Clever Fox Publishing, 2023
	3. Duffie J.A. and Beckman W.A., 'Solar Engineering of Thermal Processes', Wiley, New York.1, 2013.	7. Richard Baxter, <i>Energy Storage</i> , PennWell Books, 2005
	4. ANSI/ASHRAE Standard 55 – 2017, <i>Thermal Environmental Conditions for Human Occupancy</i> .	8. S. Kalaiselvam, R. Parameshwaran, <i>Thermal Energy Storage Technologies for Sustainability Systems Design, Assessment and Applications</i> , Academic Press, 2014

Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	20%	-	20%	-	20%	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Soumitra Mukhopadhyay, SMS India Pvt. Ltd, Kolkatta	1. Dr. P. Thirumal, GCE Bargur, India	1. Dr. R. Senthil, SRM IST
2. Mr. M. Periyasamy, NLC India, Neyveli	2. Dr. G. Kumaresan, Anna University Chennai	2. Dr. D. Premnath, SRM IST

Course Code	21NTO601T	Course Name	COMPOSITE MATERIALS	Course Category	O	OPEN ELECTIVE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics and Nanotechnology	Data Book / Codes / Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	understand the basics of composite materials
CLR-2:	grasp the difference in various types of composite materials
CLR-3:	study the bio inspired composite materials
CLR-4:	study the properties and processing of composites
CLR-5:	understand the various applications of composite materials

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	apply knowledge of composite materials in Engineering	3	-	3
CO-2:	determine the difference in various types of composite materials for engineering applications	3	-	3
CO-3:	apply the knowledge of bio inspired composite materials in engineering problems and its applications	3	-	3
CO-4:	apply knowledge of properties and processing of composite materials in Engineering	3	-	3
CO-5:	utilize the knowledge earned on composite materials for the various engineering applications	3	3	-

Module-1 - Introduction to Composite Materials	9 Hour
Conventional composite materials, Nanocomposites materials, Classification of composites based on matrix and topology, Constituents of composites, Interfaces and Interphases, scale effects, Interfacial area, Role of adhesion, Micromechanics of composites, Fatigue and creep, Thermosetting and thermoplastic matrices	
Module-2 - Types of Composite Materials	9 Hour
Composites based on polymer matrix, Polymer matrix Hybrid composites, Fiber-Reinforced Composite Materials, Carbon fiber, Glass fiber, Carbon allotropic (graphene, carbon nanotubes, fullerenes) based Matrix Composite, quantum dot-based nanocomposites, Metal matrix composites, Ceramic matrix composite, Second generation high-temperature superconducting composites	
Module-3 - Biologically Inspired Composite Materials	9 Hour
Bio nanocomposites, Biomimetic composites, Hierarchically structured bioinspired nanocomposites, Biopolymers, Biofibers, manufacturing techniques of bio-composites, mechanical properties of biofibers and bio-composites, Bio-composite structure, Composite wood, Natural and synthetic fiber reinforced composites, Fiberglass Plywood, Agriculture-waste based solid biomass green composites	
Module-4 - Properties and Processing of Composites	9 Hour
Properties of nanocomposites vs composites, Roles of the interface, Types of interfaces, Characterization of interfaces, defects; Stress and strain; thermodynamics of deformation and Hooke's law; anisotropy and elastic constants Thermal characterization, mechanical characterization, electrical characterization, mechanical, optical and electrical properties	
Module-5 - Applications of Composites	9 Hour
Nanocomposites for energy conversion - solar cells, hydrogen, batteries and supercapacitors, Flame retardant, Sensor applications, Hybrid composite materials for therapy and food packaging- Functional graphene-carbon nanotube and polymer composite applications, Composites for civilian aircraft and jet engines.	

Learning Resources	1. Krishan K. Chawla, <i>Composite Materials Science and Engineering</i> 4th illustrated edition, Springer International Publishing, 2021 2. Guanglong Ding, Ye Zhou, <i>Polymer Nanocomposite Materials Applications in Integrated Electronic Devices</i> , Wiley, 1st ed., 2021	3. Amit Sachdeva, Hee Woo Rhee, Pramod Kumar Singh, <i>Composite Materials Properties, Characterization, and Applications</i> , CRC Press, 1st ed., 2021 4. William D. Callister, Jr., David G. Rethwisch, <i>Materials Science and Engineering</i> , Wiley, 10th ed. 2020.
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Learning Assessment							
	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	20%	-	20%	-	20%	-
Level 4	Analyze	20%	-	20%	-	20%	-
Level 5	Evaluate	20%	-	20%	-	20%	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100%	

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. A Pandikumar Scientist, CSIR-CERI, TN, India, pandikumar@cecni.res.in	1. Prof. Shirish H. Sonawane, NIT Warangal, India, shirish@nitw.ac.in	1. Dr. Sandeep Kumar Lakhera, SRMIST
2. Dr. Srabanti Ghosh, CSIR-CGCRI, WB, India, srabanti@cgcri.res.in	2. Prof. R. S. Gedam, VNIT Nagpur, India, rsgedam@phy.vnit.ac.in	2. Prof. A. Karthigeyan, SRMIST

ACADEMIC CURRICULA

Project Work, Internship Courses

Regulations 2021



SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

**Kattankulathur, Chengalpattu District 603203, Tamil Nadu,
India**

Course Code	21ASP501L	21AUP501L	21BMP501L	Course Name	SPECIALIZATION PROJECT	Course Category	P	PROJECT WORK, INTERNSHIP IN INDUSTRY / HIGHER TECHNICAL INSTITUTIONS	L	T	P	C
	21BTP501L	21CEP501L	21CHP501L									
	21CSP501L	21FPP501L	21GEP501L						0	0	40	20
	21ECP501L	21EEP501L	21EIP501L									
	21MEP501L	21MHP501L	21NTP501L									

Pre-requisite Courses	<i>Nil</i>	Co- requisite Courses	<i>Nil</i>	Progressive Courses	<i>Nil</i>
Course Offering Department	<i>All</i>	Data Book / Codes / Standards	<i>Nil</i>		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	<i>provide students with the opportunity to explore a problem or issue of particular personal or professional interest</i>
CLR-2:	<i>address the problem or issue through focused study and applied research</i>
CLR-3:	<i>demonstrate the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems</i>
CLR-4:	<i>affirm students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively</i>
CLR-5:	<i>prepare a technical report and present in a professional manner</i>

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	<i>understand problem pertaining to various social relevant issues based on individual or community base</i>	2	3	3
CO-2:	<i>apply their expertise to provide a suitable long-term solution to research problems</i>	2	3	3
CO-3:	<i>impart his/her specialization knowledge in addressing issues pertaining to the society</i>	2	3	3
CO-4:	<i>recommend with suitable justification, by comparing with various standards and regulations</i>	2	3	3
CO-5:	<i>compile the output in a scientific way and present it to scientific community</i>	2	3	3

<i>The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability.</i>	
(i)	Every student shall initiate the Specialization Project related to his / her area of specialization in third semester and continue his / her work till fourth semester The Specialisation Project can be carried out either: a) in any of the Funded Projects / Research Centres / Incubation Centres within SRMIST [or] b) within any laboratories of College of Engineering and Technology [or] c) in an Industry / Research Centre outside SRMIST duly approved by the Department Project Review Committee / Panel.
(ii)	Each student will be mentored by a faculty member and monitored through periodical reviews by the Project Review Committee / Panel.
(iii)	After completion of the Specialisation Project, the student shall submit a Report/Dissertation/Thesis, and undergo the due process of assessment by ONE External and ONE Internal Examiner recommended by the head of the department and duly approved by the CoE, for successful completion of the Specialisation Project

	Continuous Learning Assessment				End Semester Examination
	Review - 1	Review - 2	Review - 3	Project Report	Viva-Voce
<i>Specialization Project</i>	10 %	20 %	30 %	10 %	30 %

Course Code	21ASP502L	21AUP502L	21BMP502L	Course Name	SPECIALIZATION PROJECT	Course Category	P	PROJECT WORK, INTERNSHIP IN INDUSTRY / HIGHER TECHNICAL INSTITUTIONS	L	T	P	C
	21BTP502L	21CEP502L	21CHP502L									
	21CSP502L	21FPP502L	21GEP502L						0	0	30	15
	21ECP502L	21EEP502L	21EIP502L									
	21MEP502L	21MHP502L	21NTP502L									

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	All Departments			Data Book / Codes / Standards	Nil

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	provide students with the opportunity to explore a problem or issue of particular personal or professional interest
CLR-2:	address the problem or issue through focused study and applied research
CLR-3:	demonstrate the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems
CLR-4:	affirm students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively
CLR-5:	prepare a technical report and present in a professional manner

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	understand problem pertaining to various social relevant issues based on individual or community base	2	3	3
CO-2:	apply their expertise to provide a suitable long-term solution to research problems	2	3	3
CO-3:	impart his/her specialization knowledge in addressing issues pertaining to the society	2	3	3
CO-4:	recommend with suitable justification, by comparing with various standards and regulations	2	3	3
CO-5:	compile the output in a scientific way and present it to scientific community	2	3	3

The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability.	
(i)	Every student shall initiate the Specialization Project related to his / her area of specialization in third semester and continue his / her work till fourth semester The Specialisation Project can be carried out in an Industry / Research Centre outside SRMIST duly approved by the Department Project Review Committee / Panel.
(ii)	Each student will be mentored by a faculty member and monitored through periodical reviews by the Project Review Committee / Panel.
(iii)	After completion of the Specialisation Project, the student shall submit a Report/Dissertation/Thesis, and undergo the due process of assessment by ONE External and ONE Internal Examiner recommended by the head of the department and duly approved by the CoE, for successful completion of the Specialisation Project

	Continuous Learning Assessment				End Semester Examination
	Review - 1	Review - 2	Review - 3	Project Report	Viva-Voce
Specialization Project	10 %	20 %	30 %	10 %	30 %

Note: Students registering for this internship also must register for Domain internship (21XXP503L).

Course Code	21ASP503L	21AUP503L	21BMP503L	Course Name	DOMAIN INTERNSHIP	Course Category	P	PROJECT WORK, INTERNSHIP IN INDUSTRY / HIGHER TECHNICAL INSTITUTIONS	L	T	P	C
	21BTP503L	21CEP503L	21CHP503L									
	21CSP503L	21FPP503L	21GEP503L									
	21ECP503L	21EEP503L	21EIP503L									
	21MEP503L	21MHP503L	21NTP503L						0	0	10	5

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	All Departments		Data Book / Codes / Standards	Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	provide an exposure to an industrial environment or research laboratory / institution
CLR-2:	acquire practical knowledge of theoretical concepts
CLR-3:	understand the organization structure, functions, and protocols

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	appreciate the functioning of an organization	3	3	3
CO-2:	apply the theoretical concepts to solve engineering problems	3	3	3
CO-3:	take up different roles in a career with confidence	3	3	3

- The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.
- The student must submit the "Training Completion Certificate" issued by the industry / company / Organisation as well as a technical report, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.
- The committee will then assess the student based on the report submitted and the presentation made.

	Continuous Learning Assessment (100% weightage)	
	Report along with completion certificate from company	Viva-Voce
Domain Internship	60%	40 %

Note: Students registering for this internship also have to register for Industry based Specialization Project (21XXP502L).
Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

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(Deemed to be University u/s 3 of UGC Act, 1956)

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India