SYLLABUS

ROBOTICS & MECHATRONICS

Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Emerging Smart Materials for Mechatronics Applications**				
Subject Code		**MECRM20S301**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

	Course Objectives:- **1.** Develop familiarity with piezoelectric materials and their use as sensors and actuators in various configurations. **2.** Develop familiarity with shape-memory alloys.	
	Course Outcomes:- **CO1:** Knowledge of various other smart materials/structures with Application examples. **CO2:** Ability to design sensors and actuators using piezoelectric materials. **CO3:** Ability to design sensors & actuators using shape memory alloys. **CO4:** Ability to analyze vibration control and damping structures using Piezoelectric materials and SMAs. **CO5:** Ability to interpret emerging technical literature related to smart materials and structures and demonstrate knowledge in a project.	
Unit	**Syllabus**	**Periods**
UNIT-I	Introduction: Smart materials and their application for sensing and actuation, Mechatronics aspects.	**10**
UNIT-II	Piezoelectric materials: Piezoelectricity and piezoelectric materials, Constitutive equations of piezoelectric materials, Piezoelectric actuator types, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning.	**10**
UNIT-III	Shape memory alloys (SMA): Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control,	**12**

	Applications of SMA in precision equipments for automobiles, trains and medical devices.	
UNIT-IV	Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems, Description.	**13**
UNIT-V	Magnetostrictive materials: Basics of magnetic properties of materials, magnetostriction: constitutive equations, types of magnetostrictive materials, Design & control of magnetostrictive actuators, Applications of magnetostrictive materials for active vibration control.	**10**
	Text Books: **1.** Jose L. Pons, Emerging Actuator Technologies, a Micromechatronics Approach, John Wiley & Sons Ltd, 2005. **2.** Ralph Smith, Smart Material Systems: Model Development, SIAM, Society for Industrial and Applied Mathematics, 2005.	
	Reference Books: **1.** F. Carpi, d. De rossi, r. Kornbluh, r. Pelrine, p. Sommer-larsen, dielectric elastomers as electromechanical transducers, elsevier, hungry, 2008. **2.** Mechatronics 2019: recent advances towards industry 4.0 Roman szewczyk, **,jiří krejsa2019 · michał nowicki**. **3.** World forum on smart materials and smart structures, B.f. spencer jr., **,m. Tomizuka · c.b. yun**2008. **4.** Emerging trends in mechatronics, Aydin azizi · 2020.	

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SYLLABUS

ROBOTICS & MECHATRONICS

Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**INTELLIGENT VISUAL SURVEILLANCE SYSTEMS**				
Subject Code		**MECRM20S302**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:-

1. Visual surveillance in dynamic scenes attempts to detect, recognize and track certain objects from image sequences, and more generally to understand and describe object behaviors.
2. The aim is to develop intelligent visual surveillance to replace the traditional passive video surveillance that is proving ineffective as the number of cameras exceeds the capability of human operators to monitor them.
3. The goal of visual surveillance is not only to put cameras in the place of human eyes, but also to accomplish the entire surveillance task as automatically as possible.

Course Outcomes:-

CO1: Knowledge of various Image Processing methods**.**
CO2: Ability to analyze motion modeling and segmentation techniques Object Detection and Classification.
CO3: To analyze Multi-Object Tracking.
CO4: Ability to analyze Human Activity Recognition.
CO5: Foster ability to understand the design Camera Network Calibration.

Unit	Syllabus	Periods
UNIT-I	Basics of Image Processing: Introduction to Image Processing methods, Image Transforms, Wavelet Transform, JPEG Image Compression, Image Formats, Color Spaces- RGB, CMY, HSI.	**10**
UNIT-II	Video Compression Standards: H. 261, H. 263, H.264, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection, motion modeling and segmentation techniques. Object Detection and Classification- Shape based object classification, motion based object	**10**

	classification, Silhouette-Based Method for Object Classification, Viola Jones object detection framework, Multiclass classifier boosting.	
UNIT-III	Multi-Object Tracking- Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking, Tracking of multiple interacting objects.	**12**
UNIT-IV	Human Activity Recognition- Template based activity recognition, Sequential recognition approaches using state models (Hidden Markov Models), Human Recognition Using Gait, HMM Framework for Gait Recognition, Description based approaches, Human interactions, group activities, Applications and challenges.	**13**
UNIT-V	Camera Network Calibration - Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocal) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras.	**10**
	Text Books: 1. Murat A. Tekalp, "Digital Video Processing", Prentice Hall, 1995. 2. Y. Ma and G. Qian (Ed.), "Intelligent Video Surveillance: Systems and Technology", CRC Press, 2009.	
	Reference Books: 1. John Wiley & Sons "Intelligent Video Surveillance Systems" Editor: Jean-Yves Dufour Print ISBN:9781848214330 |Online ISBN:9781118577851 |DOI:10.1002/9781118577851. 2. Henri Maître, "Image Processing: Overview and Perspectives" wiley online library. 3. Maheshkumar H Kolekar "Intelligent Video Surveillance Systems: An Algorithmic Approach" · 2018. 4. Poznań, Poland "Advanced Concepts for Intelligent Vision Systems". 5. "Intelligent Network Video Understanding Modern Video Surveillance Systems" By Fredrik Nilsson, Communications Axis · 2008.	

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Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Microprocessor and Embedded Systems**				
Subject Code		**MECRM20S303**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:-

1. The Purpose of the course is to provide students with the Knowledge of Microprocessors and Microcontroller.
2. To solve real world problems in an efficient manner, this course also emphasis on architecture, Programming and system design used in various day to day gadgets.

Course Outcomes:-

Students will be able to:-

CO1: Understand the design concept of embedded systems.

CO2: Develop an ALP in 8085 microprocessor using the internal organization for the given specification.

CO3: Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers, foster ability to write the programs for microcontroller.

CO4: Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.

CO5: Understand the role of embedded systems in industry.

Unit	Syllabus	Periods
UNIT-I	Introduction to Embedded Systems and microcomputers: Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded system Models, Embedded System development cycle, Challenges for Embedded system Design, Evolution of computing systems and applications. Basic Computer architecture: Von- Neumann and Harvard Architecture. Basics on Computer organizations. Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics.	**10**
UNIT-II	Microprocessor: 8086 Microprocessor and its Internal Architecture, Pin Configuration and their functions, Mode of Operation, Introduction to I/O and Memory, Timing Diagrams, Introduction to Interrupts.	**10**

UNIT-III	Microprocessor Programming & Interfacing: Introduction to assembly language, Instruction format, Assembly language programming format, Addressing mode, Instruction Sets, Programming 8086 microprocessor. Introduction to interfacing, Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller, Programmable Key board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing.	**12**
UNIT-IV	Microcontroller: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, Programming model, Addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller.Microcontroller Interfacing: Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor.	**13**
UNIT-V	Introduction to Advanced Embedded Processor and Software: ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C. Microprocessor and Embedded system Laboratories: Basic assembly language programming implementation on Microprocessor and Microcontroller. Interfacing Displays, Key boards and sensors with Microprocessors and Microcontrollers, Data Acquisition using Microprocessor and Microcontroller, Implementation of Controlling schemes for DC, Servo, Stepper motor using assembly and C programming in microprocessors and Microcontrollers.	**10**
	Text Books: 1. Introduction to Embedded Systems: Shibu K V, McGRAW Hill Publications. 2. Embedded Systems: Raj Kamal, TATA McGRAW Hill Publications. 3. Computer System Architecture: M. Morris Mano. 4. 8086 Microprocessors and Interfacings: D. Hall, TATA McGRAW Hill.	
	Reference Books: 1. The Intel Microprocessors: B. Brey, Prentice Hall Publications. 2. PIC Microcontrollers and Embedded Systems: M. A. Mazidi, R.D. Mckinlay and D. Casey, Pearson Publications. 3. Programming and Customizing the PIC Microcontroller: M. Predko, McGRAW Hill Publications. 4. Embedded C Programming and Microchip PIC: R. Barnett, L. O'Cull and S. Cox.	

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SYLLABUS

ROBOTICS & MECHATRONICS

Class		M.TECH	L	T	P	C
Semester/Year		III/II	3	-	-	3
Subject Name		BUSINESS ANALYTICS				
Subject Code		MECRM20S304				
Paper	English					
	Hindi					
Max. Marks		100				

Course Objectives:-

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships. between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.

Course Outcomes:-

Students will be able to:-

CO1: Describe knowledge of data analytics.
CO2: Describe the ability of think critically in making decisions.
CO3: Describe the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
CO4: Describe the ability to translate data into clear, actionable insights.
CO5: Analyze the Decision Analysis.

Unit	Syllabus	Periods
UNIT-I	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	10
UNIT-II	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	9
UNIT-III	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	11

UNIT-IV	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	**14**
UNIT-V	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	**14**
	Text Books: **1.** "Big Data Demystified: How To Use Big Data, Data Science And AI To Make Better. Business Decisions And Gain Competitive Advantage" by David Stephenson PhD. **2.** "Data Analytics For Beginners: Your Ultimate Guide To Learn And Master Data Analysis. Get Your Business Intelligence Right – Accelerate Growth And Close More Sales" by Victor Finch. **3.** Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press	
	Reference Books: **1.** "Data Strategy: How To Profit From A World Of Big Data, Analytics And The Internet Of Things" by Bernard Marr. **2.** "Microsoft Excel Data Analysis and Business Modeling by Wayne L. Winston Naked Statistics: Stripping the Dread from the Data" by Charles Wheelan. **3.** Business Analytics by James Evans, persons Education.	

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ROBOTICS & MECHATRONICS

Class	M.TECH	L	T	P	C
Semester/Year	III/II	3	-	-	3

Subject Name		INDUSTRIAL SAFETY
Subject Code		MECRM20S305
Paper	English	
	Hindi	
Max. Marks		100

Course Objectives:-

1. It is needed to prevent accidents in *industry* by reducing any hazard to minimum.
2. It is needed to reduce workman's compensation, insurance rate and all the cost of accidents.
3. Industrial safety is needed to check all the possible chances of accidents for preventing loss of life and permanent disability of any industrial employee, any damage to machine and material.
4. It is needed to eliminate accidents causing work stoppage and production loss.

Course Outcomes:-

Students will be able to:

CO1: Know about Industrial safety programs and toxicology, Industrial laws, regulations and source models.

CO2: To understand about fire and explosion, preventive methods, relief and its sizing methods.

CO3: To analyse industrial hazards and its risk assessment.

CO4: To analyse Fault tracing methods.

CO5: To understand about Periodic and preventive maintenance.

Unit	Syllabus	Periods
UNIT-I	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	**11**
UNIT-II	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	**10**
UNIT-III	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, **i.** Screw down grease cup, **ii.** Pressure grease gun, **iii.** Splash lubrication, **iv.** Gravity lubrication, **v.** Wick feed lubrication **vi.** Side feed lubrication, **vii.** Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	**11**
UNIT-IV	Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine,	**13**

	v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	
UNIT-V	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	**14**
	Text Books: **1.** Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services. **2.** Maintenance Engineering, H. P. Garg, S. Chand and Company.	
	Reference Books: **1.** Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.Thomas Kailath, "Linear Systems", Prentice-Hall Inc., New Jersey, 1986. **2.** Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.	

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ROBOTICS & MECHATRONICS

Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**OPERATIONS RESEARCH**				
Subject Code		**MECRM20S306**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:-

1. This module aims to introduce students to use quantitive methods and techniques for effective decisions–making.
2. model formulation and applications that are used in solving business decision problems.
3. The course is a strong step in inculcating the research aptitude in the students.

Course Outcomes:-

Students will be able to:

CO1: Apply matrix properties and functions to a given problem.
CO2: Acquire knowledge about vector spaces, eigenvalues and eigen vectors of linear operators.
CO3: Acquire knowledge about random variables, probability distribution of random variables and transformation of random variables.
CO4: Identify correlation matrices.
CO5: Find out responses of linear systems to any given input signal.

Unit	Syllabus	Periods
UNIT-I	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	**8**
UNIT-II	Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.	**10**
UNIT-III	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem – max flow problem - CPM/PERT.	**11**
UNIT-IV	Scheduling and sequencing - single server and multiple server models – deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**13**
UNIT-V	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.	**13**
	Text Books: **1.** H.A. Taha, Operations Research, An Introduction, PHI, 2008. **2.** H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982. **3.** J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.	
	Reference Books: **1.** Hitler Libermann Operations Research: McGraw Hill Pub. 2009. **2.** Pannerselvam, Operations Research: Prentice Hall of India 2010. **3.** Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010.	

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Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**-**	**-**	**20**	**10**
Subject Name		**Dissertation Phase – I**				
Subject Code		**MECRM20S307**				
Paper	**English**					
	Hindi					
Max. Marks		**250**				

Course Objectives:-

1. In this course unit, students will learn the process of research proposal writing, conducting research, and political science writing.
2. The focus is on preparing the Special Degree students for their research and dissertation writing.
3. To enable students to learn practical aspects of research.

Course Outcomes:-

CO1: Ability to synthesize knowledge and skills previously gained and applied to an in-depth

CO1: Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.

CO2: Ability to present the findings of their technical solution in a written report.

CO3: Presenting the work in International/ National conference or reputed journals.

CO4: Using linear programming approach using software.

Dissertation Phase – I

Guidelines for Dissertation Phase – I

1. As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
2. The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred Model Curriculum of Engineering & Technology PG Courses [Volume -II]
4. literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits- Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
6. **Phase – I deliverables:** A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
7. **Phase – I evaluation:** A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A.
8. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

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Class		**M.TECH**	**L**	**T**	**P**	**C**
Semester/Year		**IV/II**	**-**	**-**	**32**	**16**
Subject Name		**Dissertation Phase – II**				
Subject Code		**MECRM20S401**				
Paper	**English**					
	Hindi					
Max. Marks		**500**				

Course Objectives:-

1. In this course unit, students will learn the process of research proposal writing, conducting research, and political science writing.
2. The focus is on preparing the Special Degree students for their research and dissertation writing.
3. To enable students to learn practical aspects of research.

Course Outcomes:-

Students will be able to:-

CO1: Describe select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.

CO2: Describe synthesize knowledge and skills previously gained and applied to an in-depth

CO3: Describe present the findings of their technical solution in a written report.

CO4: Present work in International/ National conference or reputed journals.

CO5: Describe linear programming approach using software.

Dissertation Phase - II

Guidelines for Dissertation Phase – II

1. As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
2. The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
3. After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred Model Curriculum of Engineering & Technology PG Courses [Volume -II]
4. literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits- Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
5. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
6. **During phase – II,** student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
7. **Phase – II deliverables:** A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
8. **Phase – II evaluation:** Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work.