VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination – 2018-19
M.Tech IN MECHATRONICS (MTR)
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

I SEMESTER

Sl. No	Course	Course Code	CourseTitle	Teaching Hours /Week		Examination				
						Duration in hours	CIE Marks	SEE Marks	Total Marks	Credits
1	PCC	18MTR11	Applied Mathematics	04	--	03	40	60	100	4
2	PCC	18MTR12	Fluid Power Automation	04	--	03	40	60	100	4
3	PCC	18MTR13	Advanced Control Systems	04	--	03	40	60	100	4
4	PCC	18MTR14	Mechatronics System Design	04	--	03	40	60	100	4
5	PEC	18MTR15	Sensor and Signal Conditioning	04	--	03	40	60	100	4
6	PCC	18MTRL16	Fluid Power Automation Lab	-	04	03	40	60	100	2
7	PCC	18RMI17	Research Methodology and IPR	02	--	03	40	60	100	2
			TOTAL	**22**	**04**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted forthe same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as failed and have to complete during the subsequent University examination after satisfying the internship requirements.

APPLIED MATHEMATICS

Sub Code	18MTR11	CIE Marks	40	Credits:04
Hrs/ Week:	04	SEE Marks	60	
Total Hrs.:	50	Exam Marks	100	

Course Objectives:

The main objectives of the course are to enhance the knowledge of various methods in finding the roots of an algebraic, transcendental or simultaneous system of equations and also to evaluate integrals numerically and differentiation of complex functions with a greater accuracy. These concepts occur frequently in their subjects like finite element method and other design application oriented subjects.

Course Content:

MODULE 1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model.

Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration. **10 Hour**

MODULE 2

Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Numerical Differentiation and Numerical Integration: Newton – Cotes and Guass Quadrature Integration formulae, Integration of Equations, Romberg integration, Numerical Differentiation Applied to Engineering problems, High Accuracy differentiation formulae**10 Hour**

MODULE 3

System of Linear Algebraic Equations And Eigen Value Problems: Introduction, Direct methods, Cramer's Rule, Gauss Elimination Method, Gauss-Jordan Elimination Method, Triangularization method, Cholesky Method, Partition method, error Analysis for direct methods, Iteration Methods.

10 Hour

MODULE 4

Eigen values and Eigen Vectors: Bounds on Eigen Values, Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method**10 Hour**

MODULE 5

Linear Transformation: Introduction to Linear Transformation, The matrix of Linear Transformation, Linear Models in Science and Engineering. Orthogonality and Least Squares: Inner product, length and orthogonality, orthogonal sets **10 hour**

Text Books

- S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2005.
- Steven C. Chapra, Raymond P.Canale, Numerical Methods for Engineers, Tata Mcgraw Hill, th 4 Ed, 2002.
- M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

Reference Books:

- PeFind the roots of polynomials in Science and Engineering problems.

Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications.

FLUID POWER AUTOMATION

Sub Code	18MTR12	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with fluid and its application in industries
- To expose students to various hydraulic components
- To prepare for logic circuit design
- To develop students to various controls required for automation

Course Contents

Module1	
Fluid Power Generating/Utilizing Elements: Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-drive characteristics-Linear actuator-Types, mounting details, cushioning-power packs-construction, reservoir capacity, heat dissipation, accumulators-standard circuit symbols, circuit (flow) analysis. Control and regulation elements: Direction flow and pressure control valves-method of actuation,types,sizing of ports-pressure and temperature compensation, overlapped and under lapped spool valves-operating characteristics-electro hydraulic systems, electro hydraulic servo valves- different types characteristics and performance	L1,L2 10Hrs
Module 2	
Comparison of Hydraulics and Pneumatics: need for Automation, Hydraulic and Pneumatic comparison-ISO symbols for fluid power elements, Hydraulic, pneumatics-Selection criteria and examples related to selection criteria. Advanced Hydraulics: Types of proportional control devices-pressure relief, flow control, directional control, Hydraulic symbols, Spool configurations, electrical operation, Basic electrical circuit and operation, solenoid design, comparison between conventional and proportional valves	L1,L2 10hrs
Module3	
Method of control : Comparison between analogue and digital control, Proportional attributes, Ramp, Gain, dead band, Dither, Pulse width modulation, Amplifier cards, Principles of operation, Design and application, Analogue and digital, Closed loop, Internal and external feedback devices, Operation and application of closed loop system, Integrated electronics option frequency Response, Principles of operation, Bode diagrams and their use in manufacturer's data, PID control, Practical exercises, Commissioning and set up procedures, open loop circuits, closed loop circuits, Interface to the control.	L1,L2,L3 10Hrs.
Module4	
Electrical Control of Fluid power: Electrical control of Hydraulics and Pneumatics, use of relays, Timers, counters, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits, Electronic circuits for various open loop control and closed loop (Servo) control of Hydraulics and Pneumatics. Circuit Design: Typical industrial hydraulic circuit design methodology- Ladder diagram-cascade, method-truth table- karnaugh map method-sequencing circuits- combinational and logic circuits	L1,L2,L3 10Hrs.

Module5	
.Application of Propositional and Servo Valves : Velocity control, Position control and Directional control and applications example: paper industry, process industry, printing sawmill, wood working, extrusion press, power metallurgical press, continuous casting, Food and packaging, Injection moulding, Solar energy and automobile	L1,L2,L3 10Hrs.

Student will be able to

- Explain the meaning of fluid power.
- List the various applications of fluid power.
- Differentiate between fluid power and transport systems.
- Apply concept of fluid power for the industrial applications of fluid power
- Analyze and design hydraulic and pneumatic circuits

Text Books:

1. S.R.Majumdar-Pnematic System, TMH, 1995
2. Antony Esposito, Fluid Power Systems and Control, Prentice Hall,1998
3. R.Srinivasan, Hydraulic and Pneumatics control published by Vijay Nicole Imprints Private Ltd.
4. Andrew Parr, Hydraulic and Pneumatics, Butterworth-Heinemann

References:

1. Herbert R Merritt, Hydraulic control systems, John Wiely& Sons, Newyork,1967.
2. Dudbey A Peace, Basic fluid power, Prentice hall Inc,1967.
3. Peter Rohner, Fluid power logic circuit design, Macmillan press Ltd, London,1979.
4. Peter Rohner, Fluid Power logic circuit design, Mcmelan prem,1994.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

ADVANCED CONTROL SYSTEMS

Sub Code	18MTR13	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Objective:

- To introduce advanced controlsystem from a modern and intuitive perspective
- To impart analysis and design principles of control systems
- To familiarize with stability analysis
- To expose both linear and non-linear systems

Course Contents

Module1	
Mathematical models of Physical systems, Performance specification, Root locus analysisand design, frequency domain analysis and design Sampled data control systems – Introduction to con trol systems , Sampli ng process; Sampleand Hold circuit; Types of signals ; Mathematical operation on discrete time signals; Z-transform; Properties of Z-transforms; Inverse Z-transform; Solving the differential equations using Z-transform; and its Applications.	L1,L2 10Hrs
Module 2	
State space analysis- concepts of states; State space formulation; State model of linear system; State diagram and signal flow graph; State-space representation using physical variables-Electrical systems and mechanical translational system; State-space model of Mechanical translational systems and Rotational system	L1,L2 10hrs
Module3	
Stability, Controllability and Observability- Linear discrete-time systems(LDS); Transferfunction of LDS systems; Stability analysis of sampled data control systems using Jury's stability test, Bilinear transformation and Root locus technique; Similarity transformation; Eigen values and Eigen vectors; Canonical form of state model; Controllability test and Observability test using Gilbert's method of testing, Kalman'stest and Duality property.	L1,L2,L3 10Hrs.
Module4	
. Nonlinear systems- Introduction to Nonlinear systems; common physical nonlinearities;Describing function; Derivation of describing function of dead-zone and saturation nonlinearity; Derivation of describing function of saturation nonlinearity; Derivation of describing function of dead-zone nonlinearity; Derivation of describing function of relay with dead-zone and hysteresis	L1,L2,L3 10Hrs.
Module5	
Derivation of describing function of Backlash nonlinearity; Describing function analysis of nonlinear systems using polar plot and Nichols plot ; Phase plane and phase trajectories; Singular points; Stability analysis of nonlinear systems using phase trajectories ; Construction of phase trajectories by- analytical method, Isocline method, delta method; Jump response; Liapunov's stability criterion; Popov's stability criterion	L1,L2,L3 10Hrs.

Course outcome:

Students will be able to

- Analyze various control systems.
- Obtain transfer function of systems using signal flow graph and block diagram reduction.

- Analyze stability of systems.
- Apply time domain analysis of control systems.
- Analyze frequency domain of control systems

Text Books:

J. Nagarath and M.Gopal, "Control Systems Engineering", New Age Internatio nal (P)Limited, Publishers, Fourth edition – 2005
Michael Roberts, "Fundamentals of Signals & Systems", 2nd ed, Tata M cGraw-Hill,2010.
nd

REFERENCE BOOKS:

1. **"Modern Control Engineering ",** K. Ogata, Pearson Education Asia/ PHI, 4th Edition,2002.
2. **"Feedback and Control System",** Joseph J Distefano III et al., Schaum's Outlines,TMH, 2nd Edition 2007.
3. **"Discrete Time Control Systems",** Ogata K., Addison Wesley Longman, 2nd Edition,2000.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

MECHATRONICS SYSTEM DESIGN

Sub Code	18MTR14	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Objectives
To expose students to different systems related to Mechatronics
To prepare students in modelling of modelling of Microsystems and MEMS
To build and enrich the knowledge in Microsystems fabrication and manufacturing

Course Content:

Module1

Introduction: Definition and Introduction to Mechatronics Systems, Measurement Systems, Control Systems, Microprocessors Based Controllers and Applications **Study of Actuation Systems:** Pneumatic and Hydraulic Systems, Mechanical Actuation System, ElectricalActuation Systems.	L1,L2 10Hrs
Module 2	
Modelling for Mechatronics system design : Introduction, System, Mechanical System, Electrical System, Fluid system, Thermal System, Engineering system, Translational mechanical system with spring, damper and mass, Rotational mechanical system with spring, damper and mass , Modelling of electric motor, Chamber filled with fluid, Pneumatic actuator.	L1,L2 10hrs
Module3	
MEMS and Microsystems: **Introduction** –Over view of MEMS and Microsystems. Working Princ i ples of Microsystems Micro sensors, Micro actuation, MEMS With Micro actuators. **Materials for MEMS and Microsystems:** Substrate and wafers, Active substrate material, Silicon, Siliconcompound, Silicon Piezoresisters, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers.	L1,L2 10Hrs.
Module4	
Micro System Fabrication Process: Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PVD,Epitaxy, Etching. **Overview of Micro Manufacturing:** Bulk Micro Manufacturing, Surface, Micromachining, The LIGA Process**.**	L1,L2, 10Hrs.
Module5	
Fault Finding : Fault– Detection Techniques, Watch Dog Timer, Parity and Error Coding Checks, CommonHardware Faults, Microprocessor Systems, Emulation and Simulation, PLC Systems.	L1,L2,L3 10Hrs.

Course outcome:

Students will be able to

- Understand the various mechatronic system components
- Explain micro manufacturing and MEMs.
- Apply Microsystems fabrication techniques.
- Describe fault finding techniques

Text Books:

1. Mechatronics - W. Bolton, Pearson Edition
2. MEMS and Microsystems design and manufacture. HSU, TMH

Reference Books:

1. Mechatronics System Design - Shetty and Kolk, Thomson.
2. Mechatronics -Mahalik, TMH.
3. Mechatronics - HMT, TMH.
4. Understanding Electro-Mechanical Engineering: An Introduction to Mechatronics - Kamm, PHI.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

SENSORS AND SIGNAL CONDITIONING

Sub Code	18MTR15	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course learningobjective:

To expose students to various techniques of measurement
To prepare the students to analyze and examine the data.
To provide insight into multidimensional scaling for assessing and validating the results

Course Content:

Module1	
INTRODUCTION TOMEASUREMENTSYSTEM: GeneralConceptsand Terminology,SensorsClassification,GeneralInput-Output Configuration, Static Characteristics of MeasurementSystems, Dynamics Characteristics of Measurement Systems, InputCharacteristics:Impendence,PrimarySensors,Problems. **RESSISTIVE SENSORS:** Potentiometers,StrainGages,ResistiveTemperatureDetectors (RTDs),Thermistors,Magnetoresistors,LightDependent Resistors (LDRs),Resistive Hygrometers.	L1,L2 10Hrs

Module 2	
SIGNALCONDITONING FORRESISTIVESENSORS:MeasurementofResistance, VoltageDividers, Wheatstonebridge,BalanceMeasurements,Instrumentation Amplifiers, and Interference. **REACTIVE VARIATION AND ELECTROMAGNETIC SENSORS**: Capacitive Sensors, InductiveSensors,ElectromagneticSensors.	L1,L2 10hrs
Module3	
SIGNALCONDITIONINGFORREACTIVEVARIATIONSENSORS: Problems andAlternatives,ACBridges,CarrierAmplifiers,variableOscillators,Resolver–toDigital andDigital-to-ResolversConverters. **SELF-GENERATINGSENSORS:**ThermoelectricSensors:Thermocouples,Piezoelectric Sensors,PhotovoltaicSensors,ElectrochemicalSensors	L1,L2 10Hrs.
Module4	
SIGNALCONDITIONINGFORSELF- GENERATINGSENSORS: ChopperandLow-DriftAmplifiers,ElectrometerAmplifiers,ChargeAmplifiers,Noisein Amplifiers. **DIGITALSENSORS:**PositionEncoders,VariableFrequencySensors	L1,L2, 10Hrs.
Module5	
OTHERTRANDUCTION METHODS: SensorsbasedonSemiconductorsJunctions, SensorsbasedonMOSFETTransistors, Charge-CoupledSensors,Ultrasonic-basedSensors, Fiber-OpticSensors. **TELEMETRY AND DATA ACQUISTION:** Data- Acquisition System Structure, TelemetrySystems,AmplitudeTelemetry,FrequencyTelemetry	L1,L2,L3 10Hrs.

Course Outcome

Studentwillbe to

- Understand the measuring systems and their characteristics
- Interpretthe type of sensors for particular applications
- Demonstrate various signal conditioning for sensors
- Explain the transducers and telemetry and data acquisition

Text Book:

.

1. Bolton W., “Mechatronics”, Thomson Press, 2003.

2.Bradley D.A., and Dawson, Burd and Loader, “Mechatr onics”, Thomson Press

3. Ernest O. Doeblin, “Measurement system, Application and Design”, Tata McGrawHill Publishing Company Ltd., Fiftieth Edition, 2004

ReferenceBook:

1. Patranabis D., “Sensor and Actuators”, Prentice Hal l of India (Pvt) Ltd.,2005.

2. Renganathan S., “Transducer Engineering”, Allied Pu blishers (P) Ltd., 2003

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

Fluid Power Automation Laboratory

Sub Code	18MTRL16	**CIE Marks**	40	Credits:02
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Note:

1) These are independent laboratory exercises
2) A student may be given one or two problems stated herein
3) Student must submit a comprehensive report on the problem solved and give a Presentation on the same for Internal Evaluation
4) Any one of the exercises done from the following list has to be asked in the Examination for evaluation.

Exercises:

1. Study of Hydraulic Pump and to draw characteristic curve of variable displacement pump.
2: Single rod cylinder with Pressure In-intensification (Use 4/2 DCV). Exercises on Meter-in Meter-out Circuit.

3: Application Involving 4/3 Direction Control Valve: Open Centre & Closed Center

4: Application Involving 4/3 Direction Control Valve Using motor.

5: Speed Control of Single Acting Cylinder. Slow speed Extension and Rapid Retraction by using pneumatic components.

6: Position Dependent Control of a Pneumatic Double Acting Cylinder with Mechanical Limit Switches.

7: Logical Control with Shuttle and Twin-Pressure Valves of pneumatic components.

8: Sequential Control of Two Double Acting Cylinders without Overlapping Signals

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Scheme of Teaching and Examination – 2018 - 19

M.Tech Name of the programmeMECHATRONICS (MTR)

Outcome Based Education(OBE) and Choice Based Credit System (CBCS)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory			CIE Marks	SEE Marks	Total Marks	
1	PCC	18MTR21	Automotive Electronics	04	--	03	40	60	100	4
2	PCC	18 MTR22	Micro and Smart Systems	04	--	03	40	60	100	4
3	PCC	18 MTR23	Safety and Security of Mechatronics systems	04	--	03	40	60	100	4
4	PEC	18 MTR24X	Professional elective 1	04	--	03	40	60	100	4
5	PEC	18 MTR25X	Professional elective 2	04	--	03	40	60	100	4
6	PCC	18 MTRL26	Advanced Control System Lab	--	04	03	40	60	100	2
7	PCC	18 MTR27	Technical Seminar	--	02	--	100	--	100	2
TOTAL				**20**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		Professional Elective 2	
Course Code under 18MTR24X	**Course title**	**Course Code under 18MTR25X**	**Course title**
18 MTR241	Industrial Automation	18 MTR251	Programmable Logic Controller
18 MTR242	Finite Element Methods	18 MTR252	Reliability and Failure Analysis
18 MT 243	Smart Materials and Structures	18 MTR253	Vibration Analysis

Note:

1. Technical Seminar:CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do nottake-up/complete the internship shall be declared as failed and have to complete during the subsequent University examination after satisfying the internship requirements.

AUTOMOTIVE ELECTRONICS

Sub Code	18MTR21	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with automobile systems
- To expose students electronic control systems in automobiles
- To prepare for communication systems
- To develop students to integrate automotive systems

Course Contents

Module1	
Automotive fundamentals overview – four stroke cycle, engine control, ignition system , spark plug, sparkpulse generation, ignition timing, drive train, transmission, brakes, steering system, starting system.**Actuators** – fuel metering actuators, fuel injector, ignition actuator **Exhaust After – Treatment System** –AIR, catalytic converter, exhaust gas recirculatio n (EGR), Evaporativeemission systems	L1,L2 10Hrs
Module 2	
Air/ fuel system – fuel handling, air intake system, air/ fuel mana gement **Sensors:**Oxygen (02/EGO) sensors, throttle position sensor (TPS), engine crankshaft angular position (CKP)sensor, magnetic reluctance position sensor, engine speed sensor, ignition timing sensor, hall effect position sensor, shield field sensor, optical crankshaft position sensor, manifold absolute pressure(MAP) sensor-strain gauge and capacitor capsule, Engine coolant temperature(ECT) sensor, intake air temperature (AIT) sensor, knock sensor, airflow rate sensor, throttle angle sensor	L1,L2 10hrs
Module3	
Electronic Engine Control – engine parameters, variables, engine performance terms, electronic fuelcontrol system, electronic ignition control, idle speed control, EGR control **vehicle motion control** – cruise control, chassis, power brakes, antilock b rake system (ABS), electronicsteering control, power steering, traction control, electronically controlled suspension	L1,L2,L3 10Hrs.
Module4	
Communication-serial data, communication systems, protection, body and chassis electrical systems,remote keyless entry, GPS **Automotive Instrumentation**– sampling, measurement & signal conversion of vari ous parameters. Radarwarning system, low tire pressure warning system, radio navigation, advance driver information system	L1,L2,L3 10Hrs.
Module5	
. **Integrated body-** climate control systems, electronic HVAC system, Safety systems-SIR, interior safety,lighting, entertainment systems **Automotive diagnostics** – Timing light, engine analyser, on-board diagnosti c off-board diagnostics,expert systems.	L1,L2,L3 10Hrs.

Course outcomes
Student will be able to

- Explain automotive components and integration
- List the type of control systems in automobiles
- Differentiate electronic and mechanical components used in automobile systems
- Apply concept of integration of system components
- Analyze and measure signal conversion parameters

Reference Books:

1. **Willian b. Ribbens:** understanding automotive electronics, 6th edition, SAMS/Elsevierpublishing.
2. **Robert Bosch Gmbh:** Automotive electrics automotive electronics systems and components, 5th sedition, john wiley& sons ltd., 2007

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

MICRO AND SMART SYSTEMS

Sub Code	18MTR22	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with micro systems and smart materials
- To expose students to silicon fabrication and lithograpy
- To prepare for micro mechanics of solids and vibrations
- To develop students to solve by numerical methods
- To introduce to electronic packaging of micro electronics

Course Contents

Module1	
Glimpses of Microsystems; scaling effects, Smart materials and systems: an overview Micro sensors :Micro actuators Microsystems examples, structural 10Hrs monitoring and vibration control	L1,L2 health
Module 2	
Microfabrication processes Structure of silicon and other materials Silicon wafer L1,L2 processing; Thin-film deposition Lithography, wet etching and dry etching Bulk micromachining and Surface micromachining Wafer-bonding; LIGA and other moul ling techniques Soft lithography and polymer processing Thick-film 10hrs processing; Lo w temperature co-fired ceramic processing Smart material processing	

Module3	
Mechanics of Solids Stresses and deformation: bars and beams Micro device suspensions: lumped modelling Residual stress and stress gradients Poisson effect; Anticlastic curvature; examples of micromechanical structures Vibrations of bars and beams Gyroscopic effect Frequency response; damping; quality factor Basic 10Hrs. micro-flows for damping calculation	L1,L2,L3
Module4	
Types of numerical methods for solving partial differential equations, Weak form; shape functions, Isoparametric formulation and numerical integration, 10Hrs. Implementation of the finite element method,FEM for piezoelectrics	L1,L2,L3
Module5	
Electronics and packaging: Semiconductor devices: basics, Signal conditioning for microsystems devices, Integration of Microsystems and microelectronics, Packaging of Microsystems: why and how, Flip-chip, ball grid, etc.; reliability, 10Hrs. Case studies	L1,L2,L3

Course outcomes

Student will be able to

- Explain micro systems and micro sensors
- List the type of micro fabrication processes
- Differentiate electronic and mechanical components used in automobile systems
- Apply concept of mechanics of solids
- Analyze partial differentiation for micro systems
- Describe electronic packaging of micro electronics

Text Books:

1. S.D. Senturia, Microsustem Design, Kluwer Academic Publishers, 2001.
2. Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, McGraw Hill, 2002.
3. V.K. Varadan, K.J. Vinoy, and S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, Wiley, 2006.

Reference Books:

1. G.T.A. Kovacs, Micromachined Transducers Sourcebook, WCB McGraw-Hill, 1998.
2. J.W. Gardner, Microsensors: principles and applications, John Wiley & Sons, 1994.
3. M. Madou, Principles of Microfabrication, CRC Press, 1998.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

SAFETY AND SECURITY OF MECHATRONICS SYSTEM

Sub Code	18MTR23	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with safety aspects of mechatronics
- To expose students different integrating components and safety measures
- To prepare students to electrical and transmission systems
- **To** develop knowledge Mechatronics fault tolerances
- To introduce to reliability and security of mechatronics

Course Contents

Module1	
Types of Automobile. Limiting dimensions as per central motor vehicle Rules. Engine classification, construction, Materials of engine components. Prototype testing as per Central Motor Vehicle Rules Fuel System-fuel tank, Fuel filter, Types of fuel system. Carburetor- simple and modern, fuelinjection system. Emission standards as per CMV Rules	L1,L2 10Hrs
Module 2	
Electrical System – Storage battery operations and Maintenance. Ignition system - coil andMagneto Ignition system. Starting system, Lighting system, Horn system- wind shield.Wiper Motors, Fans, Heaters, Traficators. Automobile air conditioning, Central Motor Vehicle Rules regarding Lighting, windshields, wipers.	L1,L2 10hrs
Module3	
Transmission system – clutches-operation and fault finding of clutches, Fluid Flywheel**, Gear**-Box types, steering systems, chassis springs, suspension. Differential Dead and Live axles, Rims, Tyre etc. Brakes-Types , Construction and fault finding, CMV Rules- Brakes ,Steering & Tyre.	L1,L2,L3 10Hrs.
Module4	
Lubrication systems- Types, components, Lubricating oil, Cooling system – Details ofcomponents, study of systems, Types. Miscellaneous- Special gadgets and accessories for fire fighting vehicles. Automobile accidents.CMV Rules regarding safety devices for drivers, passengers	L1,L2,L3 10Hrs.
Module5	
Safety features like airbags, antilock braking systems (ABS), anti-skid systems, belt tensioners or the electronic stability program (ESP interlocked interaction of mechanics, electronics and information technology. deployment in the safety-relevant environment and fault tolerance. Fault tolerant Mechatronics. Operability and reliability	L1,L2,L3 10Hrs.

Course outcomes

Student will be able to

- Explain different safety aspects of Mechatronics
- List the integrating components of Mechatronics
- Differentiate elements of integration
- Apply fault tolerance and interdependency of elements
- Describe the operation ability and reliability of systems

References:

1) William H Crouse, Automobile chassis and body Construction, Operation and Maintenance.
2) William H Crouse, Automobile Machines –Principles and operations.
3) GBS Narang, Automobile Engineering
4) Kirpalsingh, Automobile Engimeering.
5) Joseph Hietner, Automotive Mechanics- Principles and Practices.
6) P.L.Kohli Automotive Electrical Equipments.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

INDUSTRIAL AUTOMATION

Sub Code	18MTR241	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with different production systems
- To expose students to automated material handling systems
- To prepare students to automated assembly concepts
- **To** develop knowledge related shop floor control systems
- To introduce to automated process control

Course Contents

Module1	
Automation in Production & Manufacturing Systems : Automation in Production system,Principles &Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Components of Manufacturing Systems, Classification of Manufacturing Systems, Manufacturing Cells, GT, Cellular Manufacturing, FMS, Flow lines & Transfer Mechanisms	L1,L2 10Hrs
Module 2	
Automated Assembly & Material handling Systems: Types, Parts Feeding Devices, StorageSystems,AGV's, Overview of Material Handling Systems, Automated Material Handling Systems, Principles & Design Considerations, Material Transport Systems, Overview of Automatic Identification Methods	L1,L2 10hrs
Module3	
Quality& Shop Floor Control Systems: Traditional & Modern Quality Control Methods,SPC Tools, Inspection Principle & Practices, Inspection Technologies, Computer Aided Quality Control Steering, Contact & Non-Contact Inspection Methods, Co-Ordinate Measuring Machine, Factory Data Collection Systems, Automatic Identification Systems.	L1,L2,L3 10Hrs.
Module4	
Control Technologies in Automation: Industrial Control Systems, Process Industries VersesDiscrete Manufacturing Industries, Continuous Verses Discrete Control, Computer Process & its forms. Sensors, Actuators & other Control System Components	L1,L2,L3 10Hrs.
Module5	
Computer Based Industrial Control: Introduction & Automatic Process Control, ComputerAided Process, Planning; Retrieval types, Generative type, Material Requirement Planning, Fundamental Concepts of MRP, Capacity Planning	L1,L2,L3 10Hrs.

- Explain different production systems
- List the automated manufacturing systems
- Differentiate elements of automated system
- Apply control system for automation
- Describe computer aided process planning

Text Books

1. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education
2. Computer Based Industrial Control, Krishna Kant, EEE-PHI

3. Automation, Production Systems and Computer Integrated Manufacturing, Mikell.O.Groover - PHI, New Delhi, 2002

References

1. An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A. Wysk
2. Anatomy of Automation, Amber G.H & P.S. Amber, Prentice Hall
3. Principles of CIM by Vajpayee, PHI
4. Performance Modelling of Automated Manufacturing Systems, Viswanandham,
PHI CAD/CAM by Zeid, Tata McGraw Hill. 2000

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

FINITE ELEMENT METHOD

Course Code	**18MEAMTR242**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**04**	**SEE Marks**	**60**
Total Number of Lecture Hours	**50)**	**Exam Hours**	**03**

Course Learning Objectives:

To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures.

To present Finite element formulation using variational and weighted residual approaches

To present Finite elements for the analysis of bars & trusses, beams & frames, plane stress& plane strain problems and 3-D solids, for thermal and dynamics problems.

Learn to model complex geometry problems and technique of solutions.

Course Content:

Module1	
Introduction to finite element method: basic steps in finite element method to solve mechanical engineering problems (solid, fluid and heat transfer). Functional approach and Galerkin approach. Displacement approach: admissible functions. Convergence criteria: conforming and nonconforming elements, C0, C1 and Cn continuity elements. Basic equations, element characteristic equations, assembly procedure, boundary and constraint conditions.	L1,L2 10Hrs
Module 2	
Solid Mechanics: One-dimensional finite element formulations and analysis – bars- uniform, varying and stepped cross section. Basic (Linear) and higher order elements formulations for axial, torsional and temperature loads with problems. Beams- basic (linear) element formulation-for uniform, varying and stepped cross section- for different loading and boundary conditions, numericals. Trusses, Plane frames and Space frame – basic (Line ar) elements formulations for different boundary conditions -axial, bending, torsional, and temperature loads, numericals.	L1,L2 10hrs

Module3	
Two dimensional finite element formulations for solid mechanics problems: triangular membrane (tria 3, tria 6, tria 10) element, fournoded quadrilateral membrane (quad 4, quad 8) element formulations for in-plane loading with simple problems. Triangular and quadrilateral axi-symmetric basic and higher order elements formulation for axi-symmetric loading with simple numericals. Three dimensional finite element formulations for solid mechanics problems: finite element formulation of tetrahedral element (tet 4, tet 10), hexahedral element (hexa 8, hexa 20), for different loading conditions. Serendipity and Lagrange family elements.	L1,L2,L3 10Hrs.
Module4	
Finite element formulations for structural mechanics problems: Basics of plates and shell theories: classical thin plate theory, shear deformation theory and thick plate theory. Finite element formulations for triangular and quadrilateral plate elements. Finite element formulation of flat, curved, cylindrical and conical shell elements.	L1,L2,L3 10Hrs.
Module5	
Dynamic analysis: finite element formulation for point/lumped mass and distributed masses system, finite element formulation of one dimensional dynamic analysis: bar, truss, frame and beam element. Finite element formulation of two dimensional dynamic analysis: triangular membrane and axi-symmetric element, quadrilateral membrane and axi -symmetric element. Evaluation of eigen values and eigen vectors applicable to bars, shaft, beams, plane and space frame.	L1,L2,L3 10Hrs.

Course Outcomes:
At the end of this course, students should be able to:

Understand the concepts of Variation methods and Weighted residual methods.
Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements, and 3D element.
Develop element characteristic equations and generate global stiffness equations.
Apply suitable boundary conditions to a global structural equation, and reduce it to a solvable form.
Identify how the finite element method expands beyond the structural domain, for problems involving dynamics and heat transfer.

Text Books:
1. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, Prentice Hall, 3rd Ed, 2002.
2. Lakshminarayana H. V., Finite Elements Analysis– Pr ocedures in Engineering, Universities Press, 2004.

Reference Books:
1. Rao S. S, Finite Elements Method in Engineering- 4th Edition, Elsevier, 2006
2. P.Seshu, Textbook of Finite Element Analysis, PHI, 2004.
3. J.N.Reddy, Introduction to Finite Element Method, mcgraw -Hill, 2006.
4. Bathe K. J, Finite Element Procedures, Prentice-Hall, 2006..
5. Cook R. D., Finite Element Modeling for Stress Analysis, Wiley,1995.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

SMART MATERIALS AND STRUCTURES

Sub Code	18MTR243	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course learningobjective:

To expose students to smart materials and smart structures
To strengthen the students in modelling for analysis.
To prepare the students to know the application of shape memory alloy and MR fluids
To provide insight into vibration and damping of structures

Module1	
Smart Structures: Types of Smart Structures, Potential Feasibility of Smart Structures,KeyElementsOfSmartStructures,Applications ofSmartStructures. Piezoelectricmaterials,Properties,piezoelectricConstitutiveRelations,Depolingand CoersiveField,fieldstrainrelation.Hysteresis, CreepandStrainRateeffects, InchwormLinearMotor. **BeamModelling:**BeamModelling withinducedstrainRateeffects,InchwormLinearMotor BeamModellingwithinducedstrainActuation-single Actuators,dualActuators,Pure Extension, PureBending harmonicexcitation,Bernoulli-Euler beamModel,problems, PiezoelectricalApplications.	L1,L2 10Hrs
Module 2	
ShapememoryAlloy: ExperimentalPhenomenology, ShapeMemoryEffect,Phase Transformation, Tanaka'sConstitutiveModel,testingofSMAWires,Vibration ControlthroughSMA,Multiplexing.ApplicationsOfSMAandProblems. **ERandMRFluids:**Mechanismsandproperties,FluidComposition andbehaviour,The BinghamPlasticandRelatedModels,Pre-YieldResponse.Post-Yield flowapplicationsin Clutches,DampersandOthers.	L1,L2 10hrs
Module3	L1,L2
VibrationAbsorbers: seriesandParallelDampedVibrations(OverView), Active Vibration Absorbers, FiberOptics, Physical Phenomena,Characteristics, Sensors, FiberOpticsinCrackDetection,applications. **ControlofStructures:**Modelling,ControlStrategiesandLimitations,ActiveStructuresi n Practice.	10Hrs.
Module4	
MEMS –MechanicalPropertiesofMEMSMaterials,ScalingofMecha nical Systems,FundamentalsofTheory,TheIntrinsicCharacteristicsofMEMS, Miniaturization,MicroelectronicsIntegration.	L1,L2, 10Hrs.
Module5	
Devices: SensorsandActuators,ConductivityofSemiconductors,CrystalPlanesand Orientation, (StressandStrainRelations,FlexuralBeamBendingAnalysisUnder SimpleLoadingConditions),PolymersinMEMS,OpticalMEMSApplications	L1,L2,L 3 10Hrs.

CourseOutcome:

Studentswillbeableto:

Understandthebehaviourandapplicabilityofvarioussmartmaterials

Designsimplemodelsforsmartstructures&materials

Performsimulationsofsmartstructures&materialsapplication

Conductexperimentstoverifythepredictions

TEXTBOOKS :

1. SmartMaterialsandStructures-M.V.GandhiandB.SoThompson,Chapmanand Hall, London;NewYork,1992(ISBN:0412370107).
2 SmartStructuresandMaterials- B.Culshaw,ArtechHouse,Boston,1996(ISBN :0890066817).
3. SmartStructures:AnalysisandDesign-A.V.Srinivasan,CambridgeUniversity Press,Cambridge;NewYork,2001(ISBN:0521650267).

REFERENCEBOOKS:

1. Electroceramics:Materials,PropertiesandApplications-A.J.MoulsonandJ.M. Herbert.JohnWiley&Sons,ISBN:0471497429
2. PiezoelectricSensories:Force,Strain,Pressure,AccelerationandAcousticEmission Sensors. Materials andAmplifiers, Springer, Berlin; New York, 2002 (ISBN: 3540422595).
3. Piezoelectric Actuatorsand WtrasonicMotors - K. Uchino, KluwerAcademic Publishers,Boston,1997(ISBN:0792398114).
4. HandbookofGiantMagnetostrictiveMaterials-G.Engdahl,AcademicPress,San Diego,Calif.;London,2000(ISBN:012238640X).
5. ShapeMemoryMaterials-K.OtsukaandC.M.Wayman,CambridgeUniversity Press,Cambridge;NewYork,199~(ISBN:052144487X).

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

Programmable Logic Controllers (PLCs)

Sub Code	18MTR251	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize characterstics of PLC
- To expose students to ladder diagram and gates
- To prepare students to understand counter operations of PLC
- **To** develop knowledge in data handling instructions
- To introduce to logic section specifications

Course Content:

Module1	
Technical Definition Of PLC,What Are Its Advantages, CharacteristicFunctions OfA PLC, Chronological Evolution Of PLC, Types Of PLC, Unitary PLC, Modular PLC. Small PLC,MediumPLC,LargePLCBlockDiagram Of PLC : Input / Output (I/O) Section, Processor Section, Power Supply, Memory.Central Processing Unit : Processor Software / Executive Software , Multitasking, Languages ,Ladder Language. Input And Output Contact Program Symbols , 10Hrs Numbering System Of Inputs AndOutputs, Program Form	L1, L2
Module 2	
Introduction To Logic: Equivalent Ladder Diagram Of AND Gate, Equivalent Ladder Diagram Of OR Gate, Equivalent Ladder Diagram Of NOT Gate, Equivalent Ladder Diagram Of XOR Gate, Equivalent Ladder Diagram Of NAND Gate, Equivalent Ladder Diagram Of NOR Gate,Equivalent Ladder Diagram To Demonstrate De Morgan Theorem, Ladder Design. Timer And Its Classification : Characteristics Of PLC Timer, Functions InTimer, Resetting Retentive And Non-Retentive, Classification Of PLC Timer, Or Delay And Off Delay Timers Timer-On Delay, Timer Off Delay , Retentive And Non-Retentive Timers, Format of a Timer Instruction	L1,L2 10hrs
Module3	
PLC Counter: Operation Of PLC Counter, Counter Parameters, Counter Instructions Overview Count Up (CTU) Count Down (CTD).Introduction to Comparison Instructions, Discussions On Comparison Instructions, " EQUAL." or "EQU"Instruction, "NOT EQUAL" or "NEQ" Instruction, "LESS THAN" or "LES" Instruction,"LESS THAN OR EQUAL" or "LEQ" Instruction, GREATER THAN" or "GRT" Instruction,"GREATER THAN OR EQUAL *TO"* or "GRQ" Instruction , "MASKED COMPARISON FOREQUAL" or "MEQ" Instruction, "LIMIT TEST" or "LIM" Instruction.Addressing Data Files: Format Of Logical Address. Addressing Format ForMicrologic System	L1,L2,L3 10Hrs.
Module4	
.DataMovement Instructions, Logical Instructions, Mathematical Instructions.Special Mathematical Instructions, Data Handling Instructions, Program Flow ControlInstructions, Proportional Integral Derivative (PID) Instruction. Introduction to Classification *of I/O,* I/O System Overview, Practical I/O System And Its MappingAddressing Local And Expansion I/O, Input-Output Systems, Direct f/O , Parallel I/O Systems SerialI/O Systems.Sinking And Sourcing, Discrete Input Module, Rectifier with Filter, Threshold Detection,Isolation, Logic SectionSpecifications Of Discrete Input Module and	L1,L2,L3 10Hrs.

Output Modules.Specifications Of Analog Input Module, Types Of Analog Input ModuleSpecial Input Modules, Analog Output Module, I/O Modules In HazaradousLocationsPower Supply Requirements, Power Supply Configuration, Filter	
Module5	
INDUSTRIAL COMMUNICATION AND NETWORKING Introduction: Evolution OfIndustrial Control Process, Types Of Communication Interface Types Of Networking Channels, Parallel Communication Interface, IEEE-488 Bus, Devices Useable with IEEE - 488, Handshaking Process, Interface Management Lines, Serial Communication Interface. Communication Mode, Synchronization And Timing In Communication, Synchronous And Asynchronous Transmissions Compared, Different Recommended Standards Compared Software Protocol, Industrial Network, Network Topology, Media Access Methods, Open System Interconnection (OSI) Network Model, Network Components, Advantage Of Standardized Industrial Network, Industrial Network, Controller Area Network (CAN), AS-I Interface, FOUNDATION FIELDBUS: Physical Layer (Layer 1), Communication Stack (Layers 2 and 7), User Layer (Layer 8)Introduction to Utility Of Automation, General Structure Of An Automated Process, Examples of Some Simple Automated Systems, Selection Of PLC, Introduction to various PLCs available in Seimens/Bosch. Exercise in industrial automation.	L1,L2,L3 10Hrs.

Course outcomes

Student will be able to

- Explain the characterstics of PLC
- Differentiate elements of PLC
- Apply the logic to build ladder diagram
- Describe communication and networking interfaces

Text Book: 'PLC and Industrail Applications", MadhuchhandanGupts and SamarjitSenGupta, Pernram International Pub. (India) Pvt.Ltd., 2011.

Reference Books:

1. Cite Address :www.equinoxac.co.uk
2. 'Basic PLC Course(Programmable Logic Controller)' MohdShafiekYaacob,Pearson,2006.
3. Cite Address: PLCs, ELOSTZ.com

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

RELIABILITY AND FAILURE ANALYSIS

Sub Code	18MTR252	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with reliability and failure modes
- To expose students hazard models and distributions
- To prepare students to solve complex systems related with reliability
- **To** develop knowledge in reliability improvement
- To introduce to reliability, maintainability and availability

Course Content:

Module1	
Reliability definition : introduction, definition, failure data, mean failure rate, mean time to failure, mean time between failure, graphical plots, four important points, mttfinterms of failure density, generalization, reliability in terms of hazard rate and failure density, int integral form, mean time to failure in integral form, reliability inother situations.	L1,L2 10Hrs
Module 2	
Hezard models; constant hazard, linearly increasing hazard, the weibull model, on density function and distribution function, distribution function and reliability analysis, some important distributions, choice of distribution, expected value, standard deviation and variance, theorems concerning expectation and variance	L1,L2 10hrs
Module3	
Conditional probabilities and multiplication rule, independent events, venn diagrams-sample space, probability calculation by venn diagrams, system reliability, series configuration, parallel and mixed configuration, application to specific hazard models, anr-out-of-n structure, method of solving complex system, system not reducible to mixed configurations, mean time to failure of systems, logic diagrams, markovmodels, markov graphs, system subjected to probability laws.	L1,L2,L3 10Hrs.
Module4	
Reliability improvement, improvement of components, redundancy, element redundancy, unit redundancy, stand by redundancy, optimization, reliability-cost trade-off, fault tree analysis and other techniques, fault free construction, calculation of reliability from fault tree, tie-set and cut-set, use of Boolean algebra, basic operations, truth tables, demorgan's theorem, application to reliability analysis, probability calculations	L1,L2,L3 10Hrs.
Module5	
Maintainability, availability(qualitative aspects) system down time, availability, reliability and maintainability trade-off, instantaneous repair rate, mean time to repair, reliability and availability functions, reliability allocation and applications, reliability allocation for a series system, applications, marine power plant, computer system, nuclear power plants, general complex systems, failure modes and effect analysis.	L1,L2,L3 10Hrs.

Course outcomes

Student will be able to

- Explain reliability and failure modes
- Distinguish the models for reliability
- Apply the model for a specific situation
- Illustrate the differences between reliability, maintainability and availability along with case studies.

Text Books:

1. Reliability engineering, L.S.Srinath, Affilated east-West Press Pvt Ltd, New Delhi.
2. Quality planning and analysis, Juran.J.M and Gryna.F.M, Tata Mcgraw hill Publishing company Ltd, Delhi, India.
3. An introduction to reliability and maintainability, Charles E Ebeling, TMH, Edition2000.
4. Reliability Engineering, Balaguruswamy, Tata Mcgraw Hill, Fourth edition, 2003.

Reference Books

1. The Assurance Sciences, Halpern, Seimund, Prentice hall International, New Jersey, USA,1978.
2. Hand book of Reliability Engineering and Management, Kraus, John W (1988)Ireson. W.G and Cooms.C.F, Mcgraw Hill Book Company Inc,USA.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

VIBRATION ANALYSIS

Sub Code	18MTR253	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize students to mechanical vibration
- To expose students to vibration control and signal analysis
- To prepare students to modal analysis and condition monitoring
- **To** develop knowledge in non linear vibration
- To introduce to continuous system and Euler equations

Course Contents

Module1	
Review of Mechanical Vibrations: Basic concepts; free vibration of single degree offreedom systems with and without damping, forced vibration of single dof-system. Force and motion isolation. Two dof-systems: natural frequency. **Transient Vibration of SingleDegree-of Freedom System:** impulse excitation, arbitrary excitation, Laplace transformformulation, pulse excitation and rise time, shock response spectrum, shock isolation, finitedifference numerical computation.	L1,L2 10Hrs
Module 2	
Vibration Control: introduction, vibration isolation theory, vibration isolation theory forharmonic excitation, practical aspects of vibration analysis, shock isolation, dynamic vibration absorbers, vibration dampers. **Vibration measurement and applications**: introduction, transducers, vibration pickups, frequency measuring instruments, vibrationexciters, signal analysis.	L1,L2 10hrs

Module3	
Modal Analysis and Condition Monitoring: dynamic testing of machines and structures,experimental modal analysis, machine condition monitoring and diagnosis. **Nonlinearvibrations:** introduction, source of nonlinearity, qualitative analysis of nonlinear systems.Phase plane, conservative systems, stability of equilibrium, method of isoclines, perturbationmethod, method of iteration, self-excited oscillations.	L1,L2,L3 10Hrs.
Module4	
Random Vibrations: random phenomenon, time averaging and expected value,frequency response function, probability distribution, correlation, power spectrum and powerspectral density, Fourier transforms, FTs and response.	L1,L2,L3 10Hrs.
Module5	
Continuous System: vibrating string, longitudinal vibration of rods, torsional vibration ofrods, suspension bridge as continuous system, Euler equation for beams, vibration ofmembrane.	L1,L2,L3 10Hrs.

Course outcomes

Students will be able to

- Understand basics of vibration analysis, vibration control and measurement techniques
- Apply monitoring of machine condition and fault diagnosis techniques.
- Analyse nonlinear vibration and random vibrations and their causes.

Text Books:

Theory of vibration with application, - William T. Thomson. Marie Dillon dahleh, th ChandramouliPadmanaban, 5 edition Pearson Education.

2) Fundamentals of mechanical vibration.-S. Graham Kelly. 2 nd edition McGraw Hill.
3) Mechanical Vibrations,-S.S Rao, 4th edition Pearson Education.

Reference Book:

1) Mechanical Vibrations- S. Graham Kelly, Schaum's Outlines, tata McGraw Hill, 2007.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

Advanced ControlSystemLaboratory

Sub Code	18MTRL26	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Note:

Theseareindependentlaboratoryexercises
A studentmay begivenone ortwoproblemsstatedherein
Student mustsubmitacomprehensivereporton theproblemsolved and
givea Presentation onthesameforInternalEvaluation
Anyoneof theexercisesdone fromthe followinglisthas tobeasked intheExamination
for evaluation.
Computerprogrammecanbedevelopedin 'C'or MATLAB.
ATLABSimulinkcanbeusedwhereverapplicable.

1. Mathematical models of physical systems in the design and analysis of control systems.

2. ToStudytheeffectofP,PI,PIDcontrollersusingMatlab.
3. To analysethestabilityoflinearsystemsusingBode,Rootlocus,Nyquistplots.
4. Tocalculateaninpulseresponse ofasystemdescribed by differenceequation
y[n]+0.7y[n-1]–0.45y[n-2]-0.6y[n-3]=0.8x[n]-0.44x[n-1]+0.36x[n- 2]+0.02 x[n-3]
5. QuestionbasedonresponseofLTIsystemstodifferentinputs.ALTIsystemis
definedbythedifferenceequation**y[n]=x[n]+x[n+1]+x[n+2]**.
(a)determinetheimpulseresponseofthesystem andsketchit.
(b)determinetheoutput y[n]ofthesystemwhentheinputisx[n]=u[n].
(c)Determinetheoutputofthesystemwhentheinputisacomplexexponential
(E.g.x[n]=2*exp(j0.26n)).
6. Comparison of DFT and DCT (in terms of energy compactness) Generate the
sequencex[n]=(n-64)forn=0,...127.
(a) LetX[k]=DFT{x[n]}. Forvariousvaluesof1,settozero"highfrequency
coefficients"X[64-1]= ....X[64]= ..... X[64+L]=0andtaketheinverseDFT.Plotthe results.
(b) LetXDCT[k]=DCT(X[n]).ForthesamevaluesofL,settozero"highfrequency
coefficient"XDCT[127-L]= ....XDCT[127].TaketheinverseDCTforeachcaseand
comparethereconstructionwiththepreviouscase.

and drawthe

characteristiccurvesforvariousboundaryconditions.UseLasoonenModel.

and drawthe

characteristiccurvesforvariousboundaryconditions.UseCrankNicholsenModel.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

Scheme of Teaching and Examination – 2018-19

M.Tech Name of the programme MECHATRONICS(MTR)

Outcome Based Education(OBE) and Choice Based Credit System

(CBCS) III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
									Total Marks	
1	PCC	18MTR31	Artificial Intelligence and Neural Networks	04	--	03	40	60	100	4
2	PEC	18MTR32X	Professional elective3	04	--	03	40	60	100	4
3	PEC	18MTR33X	Professional elective 4	04	--	03	40	60	100	4
4	Project	18MTR34	Evaluation of Project phase -1	--	02	--	100	--	100	2
5	Intenship	18MTRI35	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)		03	40	60	100	6
			TOTAL	12	02	12	**260**	**240**	**500**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		Professional elective 4	
Course Code under 18MTR32X	**Course title**	**Course Code under 18MTR33X**	**Course title**
18MTR321	Digital image processing and Machine vision	18MTR331	Robotics Engineering
18MTR322	Embedded Systems with Advanced Microcontroller	18MTR332	Micromachining
18MTR323	Simulation Modelling and Analysis	18MTR333	Product Design

Note:

1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.
SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as failed and have to complete during subsequent University examinations after satisfying the internship requirements.
Internship SEE (University examination) shall be as per the University norms.

ARTIFICIAL INTELLIGENCE AND NETWORKS

Sub Code	18MTR31	CIE Marks	40	Credits:04
Hrs/ Week:	04	SEE Marks	60	
Total Hrs.:	50	Exam Marks	100	

Course Learning Objectives:

- To familiarize with neural network
- To expose students multiclass networks and learning process
- To prepare for learning vector quantizing and propagations of networks
- To develop students to optimize networks

Course Contents

Module1	
Introduction, history, structure and function of single neuron, neural network architectures, neural learning, use of neural networks. Supervised learning, single layer networks, perceptions, linear separability, perceptions training algorithm, guarantees of success,modifications.	L1,L2 10Hrs
Module 2	
Multiclass networks-I,multilevel discrimination, preliminaries, back propagation, settingparameter values, theoretical results	L1,L2 10hrs
Module3	
Accelerating learning process, application, mandaline, adaptive multilayer networks. Prediction networks, radial basis functions. Polynomial networks, regularization,unsupervised learning, winner take all networks	L1,L2,L3 10Hrs.
Module4	
Learning vector quantizing, counter propagation networks, adaptive resonance theorem, toplogically organized networks, distance based learning, neo-cognition	L1,L2,L3 10Hrs.
Module5	
Associative models, hop field networks, brain state networks,BoItzmann machines, hetero associations. Optimization using hop filed networks, simulated annealing, random search, evolutionary computation.	L1,L2,L3 10Hrs.

Course Outcomes

Student will be able to

- Explain concept and need of network
- List the type of networks
- Differentiate the propagations of network
- Apply conceptof artificial intelligence for practical situations

TEXTBOOK:

1. Elements of Artificial Neural Networks, KishanMehrotra, C. K.Mohan,SanjayRanka, Penram, 1997.

REFERENCE BOOKS:

1. Artificial Neural Networks, R.Schalkoff, MGH, 1997.
2. " Artificial Intelligence and Neural Networks" by Dr K Uma Rao
3. Artificial Intelligence and Neural Networks" by F A carSavaci
4. VLSI for Artificial Intelligence and Neural Networks" by Jose G Delgado-Frias and W R Moore
5. Applied Artificial Intelligence: A compact introduction to neural networks and deep learning" by Wolfgang Beer

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

DIGITAL IMAGE PROCESSING AND MACHINE VISION

Sub Code	18MTR321	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To gain an understanding of vision and image processing
- To know the major classes thresholding and colour transformations
- To apply knowledge thresholding and segmentation
- ToAnalyze boundary description, training and testing methodologies

Course Contents

Module1	
Overview of Applications of Vision and Image Processing, Digital Image Formats, Colour Models, Data Types, Operators., Manipulating Matrices, File I/O, The Image Processing Toolbox	L1,L2 10Hrs
Module 2	
Thresholding , Histogram Equalization,• Linear Fil tering (convolution) , Noise Reduction, Nonlinear Filtering, Gradients, Edge Magnitude and Direction , Finite Difference Filters , Laplacian of Gaussian Filter, Canny Edge Detector, Colour Transformations, Colour Histogram Equalization Colour Median Filtering., Colour Gradient and Edge Detection	L1,L2 10hrs
Module3	
Thresholding as a form of Segmentation, Basic Global Thresholding, Optimal Global Thresholding, Techniques to improve global thresholding , Region Labeling , Boundary Tracing, Boundary-based measures of accuracy, Region-based measures of accuracy, Measuring Reproducibility.	L1,L2,L3 10Hrs.
Module4	
Boundary Descriptors, Region and Shape Descriptors , Texture Description , SIFT Features and Bags of Words Supervised and Unsupervised Clustering, Nearest Neighbour Classifiers , Bayesian Classification , Training and Testing Methodologies	L1,L2,L3 10Hrs.
Module5	
Introduction, definition, human visual system. Active vision system, increasing of machine vision. Machine vision components, hardware's and algorithms, image function and characteristics, image formation & image sensing frequency space analysis, Fourier transform, convolution algorithms, image gaussion, image enhancement, image analysis and segmentation data reduction, feature extraction, edge detection, image recognition and decisions, machine learning, Image processing Applications of machine vision	L1,L2,L3 10Hrs.

Course Outcomes
The students will be able to:

- Understand the typical steps for solution of image processing/vision problems: pre-processing, segmentation, description, and recognition
- Possess knowledge and understanding of basic and some advanced methods for each step in the process
- Choose appropriate methods and implement solutions to small-scale image processing and vision problems.

Text Books

- Sonka M. Hlavac V. and Doyle R., Image Processing, Analysis, and Machine Vision, PWS Publishing, 1999.
- Bose T., Digital Signal and Image Processing, Wiley, 2004.
- Forsth D. A. and Ponce J., Computer Vision: A Modern Approach, Prentice Hall, 2003.

Reference Books

- Gonzales R.C. and Woods P., Digital Image Processing, Addison-Wesley, 2002.
- Duda R. O., Hart P. E. ,and Stork D. G. ,Pattern Classification, Wiley Interscience, 2001.
- Serra J., Image Analysis and mathematical Morphology, Academic Press, 1982.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

EMBEDDED SYSTEMS WITH ADVANCED MICROCONTROLLERS

Sub Code	18MTR322	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To gain an understanding of embedded systems
- To know the major classes, components, and applications Arm processor
- To develop programming concept FPGA
- To apply knowledge of FPGA controller for real world applications

Course Contents

Module1	
INTRODUCTION TO EMBEDDED SYSTEMS AND ARM 9 CORE Definitions – Brief overview of micro-controllers - DSPs,-Typical classifications – Memory Devices and application sce narios of embedded systems. Introduction about ARM 9 Processor-DSP Processor-Sharc Processor - Internal Architecture – Modes of Operat ions – instruction set – Pipelining – AMBA – Applications and futures.	L1,L2 10Hrs
Module 2	
PROGRAMMING OF ARM PROCESSOR Programming of C – ARM Compiler - introduction to l inker – librarian – image conversion utility and supporting libraries	L1,L2 10hrs
Module3	
INTRODUCTION TO FPGA FPGA & CPLD Architectures - FPGA Programming Technologies- FPGA Logic Cell Structures- FPGA Programmable Interconnect and I/O Ports - FPGA Implementation of Combinational Circuits - FPGA Sequential Circuits - Timing Issues in FPGA Synchronous Circuits	L1,L2,L3 10Hrs.
Module4	
PROGRAMMING OF FPGA Introduction to Verilog HDL and FPGA Design flow with using Verilog HDL - FPGA Arithmetic Circuits - FPGAs in DSP Applications - Design of SDRAM & Halftone Pixel Converter - Programming FPGAs. Introduction to DSP processor - TMS320C54x and TMS320C6x architecture	L1,L2,L3 10Hrs.
Module5	
. **APPLICATIONS OF ARM 9 AND FPGA CONTROLLERS** Specific examples of time-critical and safety-critical embedded systems - applications in automation- automotive – aerospace - medical and manufacturing	L1,L2,L3 10Hrs.

Course Outcomes

The students will be able to:

1. Understand concept of embedded systems.
2. Apply the knowledge for the effective use of advanced controllers and its programming in real time product development
3. Demonstrate programming skills of FPGA

REFERENCES

1. Ball S.R., “Embedded microprocessor Systems – Real World Design”, Prentice Hall, 2006.
2. C.M. Krishna, Kang G. Shin, “Real Time systems”, Mc Graw Hill, 2009.
3. Frank Vahid and Tony Givagis, “Embedded System Desi gn”.Wiley, 2001.
4. P. Chu, “FPGA Prototyping by Verilog Examples,” Wil ey, 2008

5. Steve Kilts, "Advanced FPGA Design," Wiley Inter-Sc ience, Wiley-IEEE Press, 2007.
6. Tim Wilmshurst, "An Introduction to the Design of S mall – Scale Embedded Systems", Palgrave Macmillan, 2011.
7. Wayne Wolf, "Computers as Components – Principles o f Embedded Computing System Design", Morgan Kaufmann Publisher s 2009.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

SIMULATION MODELLING AND ANALYSIS

Sub Code	18MTR323	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize modeling and simulation
- To expose students discrete event simulation
- To prepare students to random number generation and techniques
- **To** develop knowledge design and evaluation of simulation experiments

Course Content:

Module1	
Introduction: PrincipleofComputerModelingandSimulation- MonteCarlosimulation. Nature ofComputer - modelling and simulation. Limitations ofsimulation, areas of applications. System and Environment:Componentsof a system – disc rete and continuoussystems, Modelsofasystem–avarietyofmodell ingapproaches	L1,L2 10Hrs
Module 2	
DiscreteEventSimulation: Conceptsindiscreteeventsimulation,manualsimulationus ing eventscheduling,singlechannelqueue,twoserverqueue,simulationofinventory problem.StatisticalModelsinsimulation:Discretedistributions,continuousdistributio ns,Numericals.	L1,L2 10hrs
Module3	
RandomNumberGeneration: Techniquesforgeneratingrandomnumbers– Midsquare method–themodproductmethod–Constantmul tipliertechni que–Additive Congruential method–Testsforrandomnumbers–TheKolmog orov–Smimovtest,Chi-square test	L1,L2, L3 10Hrs.
Module4	
RandomVariateGeneration: Inversiontransformstechnique– exponentialdistribution.Uniformdistribution, weibuldistribution, continuous distribution, generating,approximate normalvariates– Erlangdistribution.EmpiricalDiscreteDistribution:Discreteuniform–distribution, Poissondistribution– geometricdistribution–acceptan ce– rejectiontechniqueforPoissondistribution, gamma distribution.	L1,L2, L3 10Hrs.

Module5	
DesignandEvaluationofSimulationExperiments: Variancereductiontechniques– L1,L2,L3 antitheticvariables,variables– verificationandvalidationofsimulationmodels,simulation softwareandpackages	10Hrs.

Course Outcomes

Student will be able to

- Explain concept of simulation
- Differentiate discrete and random variable simulation
- Apply the concept of simulation to practical application
- Describe evaluation of simulation

Text Books:

1. DiscreteEventSystemSimulation– JerryBanks&JohnSCa rsonII,PrenticeHall Inc.,1984.
2. SystemsSimulation–GordanG.,PrenticeHallIndiaLtd.

,1991. ReferenceBooks:

1. SystemSimulationWithDigitalComputer–NusingDeo,Pr en ticeHallof India,1979.
2. ComputerSimulationandModeling–FrancisNeelamkovil ,J ohnWiley&Sons,1987.
3. SimulationModelingwithPascal–RathM.Davis&RobertM OK eefe,PrenticeHallInc.1989.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module

ROBOTICS ENGINEERING

Sub Code	18MTR331	**CIE Marks**	40	Credits:04

Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To familiarize with anatomy of robots and configuration
- To expose students kinematics of robot
- To enhance knowledge in control and sensing elements of robot
- To develop students to programming of robots

Course Contents

Module1	
Definition need and scope of Industrial robots – Ro bot anatomy – Work volume – Precision movement – End effectors – Senso rs. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Me thods for orientation and location of objects.	L1,L2 10Hrs
Module 2	
Controlling the Robot motion – Position and velocit y sensing devices – Design of drive systems – Hydraulic and Pneumatic d rives – Linear and rotary actuators and control valves – Electro hydra ulic servo valves, electric drives – Motors – Designing of end effectors – Vacu um, magnetic and air operated grippers	L1,L2 10hrs
Module3	
Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Imag e Representation - Image Grabbing – Image processing and analysis – Edg e Enhancement – Contrast Stretching – Band Rationing - Image segmen tation – Pattern recognition – Training of vision system	L1,L2,L3 10Hrs.
Module4	
Methods of Robot Programming – Characteristics of t ask level languages lead through programming methods – Motion interpola tion. Artificia l intelligence – Basics – Goals of artificial intelli gence – AI techniques – problem representation in AI – Problem reduction an d solution techniques - Application of AI and KBES in Robots.	L1,L2,L3 10Hrs.
Module5	
Robot work cell design and control – Safety in Rob otics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.	L1,L2,L3 10Hrs.

Course Outcomes

Student will be able to

- Explain congiguration and kinematics of robot
- Differentiate controlling and sensing elements of robots
- Analyze kinematics of robot

REFERENCES

1. Deb, S.R.” Robotics Technology and Flexible Automat ion”, Tata Mc Graw-Hill, 1994.

2. Groover,M.P., Weis,M., Nagel,R.N. and Odrey,N.G., " Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int., 1986.
3. Jordanides,T. and Torby,B.J., ,"Expert Systems a nd Robotics ", Springer – Verlag, New York, May 1991.
4. K.S.Fu, Gonzalez, R.C. and Lee, C.S.G., "Robotics C ontrol, Sensing, Vision and Intelligence", McGraw Hill, 1987.
5. Klafter,R.D., Chmielewski, T.A. and Negin,M., "Robo tics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
6. Koren,Y., "Robotics for Engineers", McGraw-Hill, 19 87.
7. Kozyrey, Yu. "Industrial Robots", MIR Publishers Mo scow, 1985.

Scheme of Examination:
Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

MICROMACHINING

Sub Code	18MTR332	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course Learning Objectives:

- To gain an understanding of standard microfabrication techniques and the issues surrounding them.
- To know the major classes, components, and applications of microsystems and to demonstrate an understanding of the fundamental principles behind the operation of these systems
- To understand the unique requirements, environments, and applications of microsystems.
- To apply knowledge of microfabrication techniques and applications to the design and manufacturing of a microsystem.

Course Contents

Module1	
Introduction to Micromachining: Historical background, classification, Need and applications of Micromachining in engineering industries Introduction, scaling laws and difference between macro and micro machining. Mechanical type advanced micro machining processes, Abrasive jet micro machining(AJJM),ultrasonic micromachining(USSM),Abrasive water jet micromachining	L1,L2 10Hrs
Module 2	
Traditional Micromachining Processes: Diamond Turning, Micro- milling, Micro grinding. Mechanical Advanced Micromachining And Nano-finishing Processes: Abrasive Jet Micromachining, Ultrasonic Micromachining, Abrasive Water Jet Machining, Abrasive Flow nano finishing.)	L1,L2 10hrs
Module3	

Abrasive flow finishing(AFF) Chemo mechanical polishing(CMP),Magnetic Abrasive finishing(MAF),Magneto rheological finishing(MRF),Abrasive flow finishing(AFF) Magnetic float polishing(MFP	L1,L2, L3 10Hrs.
Module4	
Electric discharge Micromaching(EDMM) Wire EDM,EDDG,ELID,Laser Beam Micromachining(LBMM), ElectronBeamMicromachining(EBMM),ElectrochemicalMicromaching(ECMM), Electrochemical Micro Deburring, Photochemical Micromachining	L1,L2, L3 10Hrs.
Module5	
Theory Of Micromachining – Chip Formation – Size Ef fect In Micromachining – Microturning, Micromilling, Microdrilling – Mic roma chining Tool Design – Precision Grinding – Partial Ductile Mode Grinding – Ultraprecision Grinding – Binderless Wheel – Free Form Optics.	L1,L2, L3 10Hrs.

Course Outcomes

The students will be able to:

1. Model the material removal and tool wear rate in various micro machining processes
2. Analyze the processes and evaluate the role of each process parameter during micro machining of various advanced materials.
3. Design the requirements to achieve best quality of machined surface while micro machining of various industrial engineering materials

REFERENCES:

1. Micro-Cutting: Fundamentals and Applications by Cheng, Huo, Wiley Publication
2. Introduction to Micromachining 2nd Edition, Ed. V. K. Jain, Narosa Publishing House, ISBN: 978-81-7319-915-8.
3. Precision Manufacturing by David Dornfeld and Dae-Eun Lee, Springer US

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

PRODUCT DESIGN

Sub Code	18MTR333	**CIE Marks**	40	Credits:04
Hrs/ Week:	04	**SEE Marks**	60	
Total Hrs.:	50	**Exam Marks**	100	

Course learning Objectives:

To familiarise with latest development in product design
To expose students to various stages of product design
To develop in the area of industrial design and product development

Course Contents

Module1	
DEVELOPMENT PROCESSES AND ORGANIZATION: Characteristics of successful product development, Designanddevelopmentofproduct, Duration andcostof product development, the challenges of product development, A generic development process,conceptdevelopment:thefront-endprocess,adopting thegenericproduct developmentprocess,theAMFdevelopmentprocess,productdevelopmentorganization, the AMForganization.	L1,L2 10Hrs
Module 2	
PRODUCTPLANNING, IDENTIFYINGCUSTOMERNEEDSANDPRODUCT SPECIFICATION: Theproductplanningprocess,identifyingopportunities,Evaluateand prioritizeprojects,allocateresourcesandplantiming,completepreprojectplanning,refle ct all theresultsandprocess. Gatherrawdatafromcustomers, interpretrawdataintermsofcustomerneeds,organize the needs into ohierarchy, establishtherelative importanceof theneeds and reflecton theresults andtheprocess.Whatarespecifications,whenarespecificationsestablishing target specifications,settingthefinalspecifications.	L1,L2 10hrs
Module3	
CONCEPTGENERATION,SELECTIONANDTESTING: Theactivitiesofconceptgenerationclarifytheproblem,searchexternally,searchinternall y, exploresystematically,reflectontheresultsandtheprocess. Overview ofconceptselection methodology, conceptscreening,andconceptscoring,Definitionandthepurposeofconcept test, choose a surveypopulation, choose a survey format, communication the concept, measure customerresponse,interprettheresult,reflectontheresultsandtheprocess.	L1,L2 10Hrs .

Module4	
PRODUCT ARCHITECTURE WhatisproductArchitecture, implicationsoftheArchitecture,EstablishingtheArchitecture,Varietyandsupply chainconsiderations,platformplanning,andrelatedsystemleveldesign issues. **INDUSTRIAL DESIGN:** Assessing the need for industrial design, the impact of industrialdesign,industrialdesign process, managing theindustrialdesignprocess,assessing thequalityofindustrialdesign	L1,L2, 10Hrs.
Module5	
: **PRODUCT DEVELOPMENT:** Elements of economic analysis, base case financial mode, sensitive analysis, project trade- offs, influence of qualitative factors on project success,qualitativeanalysis. **MANAGINGPROJECTS:**Understandingandrepresentingtask,baselineproject planning, acceleratingprojects,projectexecution,post-mortemprojectevaluation.	L1,L2,L3 10Hrs.

Courseoutcome:

- Student will be able to
- Understand the types of industries and need for development
- Explain various stages of product design development
- Apply the concept of product architecture.
- Analyze the economics and qualitative factors on project execution

ReferenceBook:

ProductDesignandDevelopmentbyKarlT Ulrich,StevenDEppinger,AnitaGoyal.

Scheme of Examination:

Two questions to be set from each module. Students have to answer five full questions, choosing one full question from each module.

VISVESVARAY A TECHNOLOGICAL UNIVERSITY, BELAGAVI
Schem e of Teaching and Examination – 2018 - 1 9
M.Tech IN MECHATRONICS (MTR)

Outcome Based Ed ucation(OBE) and Choice Based Credit System (CBCS)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination			Credits
1	Project	18MTR41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Phase-2:

CIE marks shall be awarded by a commi ttee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Pro ject Report subjected to plagiarism check, Project Presentation skill and Questi on and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Pro ject work evaluation and Viva-Voce examination (SEE), a fter satisfying the plagiarism check, shall be as per the University norms.