VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM

SCHEME OF TEACHING AND EXAMINATION FOR

M.TECH. Mechatronics

I SEMESTER CREDIT BASED

Subject Code	Name of the Subject	Teaching hours/week		Duration of Exam inHours	Marks for		Total Marks	CREDITS
		Lecture	Practical / FieldWork / Assignment/ Tutorials		I.A.	Exam		
16MDE11	Applied Mathematics	4	2	3	20	80	100	4
16MTR12	Fluid Power Automation	4	2	3	20	80	100	4
16MTR13	Advanced Control Systems	4	2	3	20	80	100	4
16MTR14	Mechatronics System Design	4	2	3	20	80	100	4
	Elective-I	4	2	3	20	80	100	4
16MTR15	Mechatronics Engineering Fluid Power Automation Lab 1	--	3	3	20	80	100	2
16MTR16	Seminar	--	3	--	100	--	100	1
	Total	20	16	18	220	480	700	23

ELECTIVE-I			
16MTR 151	Automotive Electronics	16 MTR 153	Industrial Automation
16MTR 152	Micro and Smart Systems Technology	16MTR 154	Mechatronic systems in Automobile Engineering

APPLIED MATHEMATICS

(Common to MDE,MMD,MEA,CAE,MCM,MAR,IAE,MTP,MTH,MTE,MST,MTR)

Sub Code : 16MDE11	IA Marks :20
Hrs/ Week : 04	Exam Hours : 03
Total Hrs: 50	Exam Marks :80

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:

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, Conservation Laws ofEngineering.**06 Hours**

2. Roots of Equations: Bracketing methods-Graphical method, Bisection method, False position method, Newton- Raphson method, Secant Method. Multiple roots, Simple fixed point iteration.
   Roots of polynomial-Polynomials in Engineering and Science, Muller's method, Bairstow's Method Graeffe's Roots Squaring Method. **12 Hours**

3. 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**06 Hours**

4. 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.
   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 .**16 Hours**

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, Orthogonal projections, The Gram-schmidt process, Least Square problems, Inner product spaces**. 12 Hours**

Text Books:

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

Reference Books:

1. Pervez Moin, Fundamentals of Engineering Numerical Analysis, Cambridge, 2010.
2. David. C. Lay, Linear Algebra and its applications, 3^{rd} edition, Pearson Education, 2002.

Course Outcomes:

The Student will be able to

1. Model some simple mathematical models of physical Applications.
2. Find the roots of polynomials in Science and Engineering problems.
3. Differentiate and integrate a function for a given set of tabulated data, for Engineering Applications

FLUID POWER AUTOMATION

Sub Code:16MTR12	**IA Marks:20**
Hrs/ Week:04	**Exam Hours:03**
Total Hrs.:50	**Exam Marks:80**

Course Objectives

1. Introduce the various aspects of FPA as applied to engineering problems .
2. Apply the fundamental concepts of Fluid power and to obtaining solution to engineering problems.

Course Content:

1.Fluid Power Generating/Utilizing Elements: Hydrulic 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 characterstics-electro hydraulic systems,electro hydraulic servo valves- different types characterstics and performance.

12 Hours

2.Comparison of Hydraulics and Pneumatics: need for Automation, Hydraulic and Pneumatic comparision-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. **12 Hours**

3.Method of control : Comparison between analogue and digital contril, 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.

8 Hours

4.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 circuit. **12 Hours**

5.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.

6 Hours

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.
5. Servo Pneumatics D Schilz A Zimmermann.

Course Outcome: The student will be able to understand hydraulic and pneumatic in the field of engineering and this will help him in his projects works.

ADVANCED CONTROL SYSTEMS

Sub. Code	**: 16MTR13**	**IA Marks**	**: 20**
Hrs/ Week	**: 04**	**Exam Hours**	**: 03**
Total Hrs.	**: 50**	**Exam Marks**	**: 80**

Course Objective: This Syllabus addresses the need for a text that teaches advanced control system from a modern and intuitive perspective. The chosen topics, the order, and the depth and breadth so as to efficiently impart analysis and design principles of control systems that the students will find useful as they enter the industry or graduate school.

1: Mathematical models of Physical systems, Performance specification, Root locus analysis and design, frequency domain analysis and design.

10 hours

2 : Sampled data control systems – Introduction to con trol systems , Sampling process; Sample and 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.

10 hours

3: 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 systems.

10 hours

4 : Stability, Controllability and Observability- Linear discrete-time systems(LDS); Transfer function 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's te st and Duality property.

10 hours

5: 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; 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.

10 hours

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Text Books:

1. **A. NagoorKani , "Advanced Control Theory" , RBA Pu blications, 2 edition, 1999.**

2. **J. Nagarath and M.Gopal**, "Control Systems Engineering", New Age Internatio nal (P) Limited, Publishers, Fourth edition – 2005
3. **Michael Roberts,** "Fundamentals of Signals & Systems", 2nd ed, Tata M cGraw-Hill, 2010.
4. **Simon Haykin,** "Signals and Systems", John Wiley India Pvt. Ltd., 2nd Edn, 2008.

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.

Course outcome:

Students will be

1. Able to analyze various control systems.
2. Able to obtain transfer function of systems using signal flow graph and block diagram reduction.
3. Able to obtain stability of systems.
4. Able to make time domain analysis of control systems.
5. Able to make frequency domain analysis of control systems

MECHATRONICS SYSTEM DESIGN

(Common to MCM,MAR,IAE,MTR)

Sub Code	: 16MTR16	***IA Marks***	: 20
Hrs/ Week	: 04	Exam Hours	: 03
Total Hrs.	: 50	Exam Marks	: 80

Course Objectives

The course gives exposure to mechatronics system design and knowledge of MEMS and Microsystems

Course Content:

1. **Introduction:**Definition and Introduction to Mechatronic Systems, Measurement Systems, Control Systems, Microprocessors Based Controllers and Applications

Study of Actuation Systems: Pneumatic and Hydraulic Systems, Mechanical Actuation System, Electrical Actuation Systems.

12 Hours

2. **Modeling 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 , Modeling of electric motor, Chamber filled with fluid, Pneumatic actuator.

10 Hours

MEMS and Microsystems:

3. **Introduction** –Over view of MEMS and Microsystems. Working Princ iples of Microsystems Micro sensors, Micro actuation , MEMS With Micro actuators.

Materials for MEMS and Microsystems: Substrate and wafers, Active substrate material, Silicon, Silicon compound, Silicon Pezoresisters, Gallium Arsenide, Quartz, Piezoelectric crystals, Polymers.

10 Hours

4. **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**.**

10 Hours

5. **Fault Finding :**Fault–Detection Techniques, Watch Dog Timer, Parity and Error Coding Checks, Common Hardware Faults, Microprocessor Systems, Emulation and Simulation, PLC Systems.

8 Hours

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.

Course Outcome:

Students are able to acquaint themselves with the application of mechatronics systems in various engineering applications.

Mechatronics Engineering Fluid Power Automation Laboratory - Lab 1

Subject Code:16MTR16	**IA Marks : 20**
Hours/Week : 6	**Exam Hours : 03**
Total Hours : 84	**Exam Marks : 80**

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.

AUTOMOTIVE ELECTRONICS

Sub code	**:**	**16MTR151**	**IA Marks**	**:**	**20**
Hrs. /Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**80**

Course objective:

The subject gives deep insight regarding the automotivesand the electro mechanical devices used in automobiles.

Course Contents:

1. **Automotive fundamentals overview** –four stroke cycle, engine control, ignition system , spark plug, spark pulse 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), Evaporative emission systems **12 Hours**

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 **06 Hours**

3. **Electronic Engine Control** – engine parameters, variables, engine performance terms, electronic fuel control system, electronic ignition control, idle speed control, EGR control

vehicle motion control – cruise control, chassis, power brakes, antilock b rake system (ABS), electronic steering control, power steering, traction control, electronically controlled suspension. **12Hours**

4. **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. Radar warning system, low tire pressure warning system, radio navigation, advance driver information system **8Hours**

5. **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 cs, off- board diagnostics, expertsystems. **12Hours**

Reference Books:

1. **Willian b. Ribbens:** understanding automotive electronics, 6th edition, SAMS/Elsevier publishing.

2. **Robert Bosch Gmbh:** Automotive electrics automotive electronics systems and components, 5th sedition, john wiley& sons ltd., 2007

Course outcome: Student shall demonstrate the knowledge associated with the automotive electronics.

MICRO AND SMART SYSTEMS TECHNOLOGY

Sub code	**:**	**16MTR152**	**IA Marks**	**:**	**20**
Hrs. /Week	**:**	**04**	**Exam Hours**	**:**	**03**
Total Hrs.	**:**	**50**	**Exam Marks**	**:**	**80**

Course Objective:

Knowledge of Micro and Smart system Technology is essential for Mechatronic students and the course aims at training students in smart Mechatronic systems,sensors etc.

Course Content:

1. Introduction:

a) What are smart material systems? Evolution of smart materials, structures and systems. Components of a smart system. Application areas. Commercial products.

b) What are microsystems? Feynman's vision. Micromachiend transducers. Evolution of micro-manufacturing. Multi-disciplinary aspects. Applications areas. Commercial products.

Micro and smart devices and systems: principles and materials:

a) Definitions and salient features of sensors, actuators and systems.
b) Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyser, conductometric gas sensor, fiber=optic gyroscope and surface acoustic – wave based wireless strain sensor.
c) Actuators : silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic com-drive and micromotor, magnetic micro relay, shape memory-alloy based actuator, electro-thermal actuator
d) Systems: micro gas turbine, portable clinical analzer, active noise control in a helicopter cabin.

12 Hour

2. Micro-manufacturing and material processing:

a) Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding and metallization.
b) Silicon micromachining: surface, bulk, moulding, boding based process flows.
c) Thick-film processing:
d) Smart material processing:
e) Processing of other materials: ceramics , polymers and metals
f) Emerging trends

06 Hours

3. **Modelling:**
    a) Scaling issues.
    b) Elastic deformation and stress analysis of beams and plates. Residual stresses and stress gradients. Thermal loading. Heat transfer issues. Basic fluids issues.
    c) Electrostatics. Coupled electro-mechanics. Electromagnetic actuation. Capillary electo-phoresis. Piezoresistivemodelling. Piezoelectric modelling. Magnestrictive actuators.

Computer- aidded simulation and design:
Background to the finite element method. Coupled-domain simulation using Matlab. Commercial software.

16 Hours

4. **Electronics, circuits and control:**

Carrier cocentartions, semiconductor diodes, transistors, MOSFET amplifiers, operational amplifiers. Basic Op-Amp circuits. Charge-measuring circuits. Examples from microsystems. Transfer function, state- space modelling, stability, PID controllers, and model order reduction. Exmples from smart systems and micromachined accelerometer or a thermal cycler. **08 Hours**

5. **Integration and packing of microelctro mechanical systems:**

Integration of microelectronicsmicro devices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Low temperature-corfired-ceramic (LTCC) multi-chip-module technology. Microsystem packaging examples.

Case studies:
BEL pressure sensors, thermal cycler for DNA amplification and active vibration control of a beam.

10 Hours

Reference Books:

1. **"Micro and Smart Systems"** by Dr. A. K. Aatre, prof. Ananthsuresh, prof. K.J. Vinoy, Prof. S. Gopalakrishna, Prof. k. n. Bhat., John Wiley Publications
2. **MEMS Microsystems:** Design and Manufacture, Tai-Ran Tsu, Tata Mc-Graw-Hill

Course Outcome:

Students will be able to develop expertise in Micro and smart systems, MEMS micro systems.

Course Outcome:

Students will be able to demonstrate their knowledge in Micro and Smart System Technology in Industrial applications.

INDUSTRIAL AUTOMATION

Sub Code:16MTR153	**IA Marks:20**
Hrs/ Week:04	**Exam Hours:03**
Total Hrs.:50	**Exam Marks:80**

Course Objective:

Student belonging to Mechanical as well as Electronics branches of Engineering are made to learn certain fundamental topics related to the Automation Production Systems and Computer Integrated Manufacturing so that they will have minimum understanding of Automation & Control Technologies, Material handling & Quality Control in Manufacturing Systems.

Course Content:

1.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.

12 Hours

2. Automated Assembly & Material handling Systems: Types, Parts Feeding Devices, Storage Systems,AGV's, Overview of Material Handling Systems, Automated Material Handling Systems, Principles & Design Considerations, Material Transport Systems, Overview of Automatic Identification Methods. **10 Hours**

3. 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.

12 Hours

4. Control Technologies in Automation : Industrial Control Systems, Process Industries Verses Discrete Manufacturing Industries, Continuous Verses Discrete Control, Computer Process & its forms. Sensors, Actuators & other Control System Components.

8 Hours

5. Computer Based Industrial Control: Introduction & Automatic Process Control, Computer Aided Process, Planning; Retrieval types, Generative type, Material Requirement Planning, Fundamental Concepts of MRP, Capacity Planning.

8 Hours

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
5. CAD/CAM by Zeid, Tata McGraw Hill. 2000

Course Outcome: Student shall demonstrate the knowledge associated with the Automation in Production & Manufacturing Systems, Automated Assembly & Material handling Systems, Quality & Shop Floor Control Systems, Control Technologies in Automation, Computer Based Industrial Control systems.

MECHATRONIC SYSTEMS IN AUTOMOBILE ENGINEERING

Sub code	**: 16MTR154**	**IA Marks**	**: 20**
Hrs/week	**: 04**	**Exam Hours**	**: 03**
Total Hrs.	**: 50**	**Exam Marks**	**: 80**

Course Objective:

Knowledge of Automobile engineering is essential for Mechatronic students and the course aims at training students in Mechatronic systems in Automotive Industry.

Course Content:

1: 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 .

7Hours

2: Fuel System-fuel tank, Fuel filter, Types of fuel system. Carburetor- simple and modern ,fuel injection system. Emission standards as per CMV Rules.

7Hours

3: Electrical System – Storage battery operations and Maintenance. Ignition system - coil and Magneto 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.

12Hours

4: 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.

12Hours

5: Lubrication systems- Types, components, Lubricating oil, Cooling system –Details of components, study of systems, Types.
Miscellaneous- Special gadgets and accessories for fire fighting vehicles. Automobile accidents.CMV Rules regarding safety devices for drivers, passengers.

12Hours

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.
7) The Central Motor Vehicle Rules 1989

Course Outcome:

Students will be able to develop expertise in Safety, security and

Manufacturing of Mechatronic devices used in Automotive industry.