M.Tech – Automotive Technology

COURSE STRUCTURE

1st SEMESTER

Code	Subject	Contacts period per week				Full Marks	Credit
		L	T	P	Total		
Theory							
MAE 101	Advanced Engg. Maths.	3	1	0	4	100	4
MAE 102	**Compulsory :** Advanced Vehicle Dynamics	4	0	0	4	100	4
MAE 103	**Compulsory :** Engine Design	4	0	0	4	100	4
MAE 104	**Compulsory :** Advanced Automotive Electronics	4	0	0	4	100	4
MAE 105	**Elective - I :**	4	0	0	4	100	4
	A) Combustion Engineering						
	B) Soft Skill						
	C) Finite Element Analysis						
	Total of Theory				**20**	**500**	**20**
Practical							
MAE 191	**LAB - I :** Auto Electronics	0	0	3	3	100	2
MAE 192	**LAB-II :** Auto Component Design	0	0	3	3	100	2
	Total of Practical				**6**	**200**	**4**
Sessional							
MAE 181	**Seminar - I**	0	2	0	2	100	1
	Total Credit of 1st Semester				**28**	**800**	**25**

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2nd SEMESTER

Code	Subject	Contacts period per week				Full Marks	Credit
		L	T	P	Total		
Theory							
MAE 201	**Compulsory :** Industrial Robotics	4	0	0	4	100	4
MAE 202	**Compulsory :** Automation and Flexible Manufacturing Systems	4	0	0	4	100	4
MAE 203	**Compulsory :** Automotive Materials	4	0	0	4	100	4
MAE 204	**Elective - II :**	4	0	0	4	100	4
	A) Automotive Emission & Alternative Fuels						
	B) Fluid Drives and Control						
	C) Noise & Vibration						
MAE 205	**Elective - III:**	4	0	0	4	100	4
	A) Material Handling System						
	B) Vehicle Design						
	C) Tribology						
	Total of Theory				**20**	**500**	**20**
Practical							
MAE 291	**LAB - III :** CAD-CAM Lab**.**	0	0	3	3	100	2
Sessional							
MAE 281	**Seminar - II**	0	2	0	2	100	1
MAE 282	Comprehensive Viva-Voce Examination					100	4
	Total Credit of 2nd Semester				**26**	**800**	**27**

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3rd SEMESTER

Code	Subject	Contacts period per week				Full Marks	Credit
		L	T	P	Total		
Theory							
MAE 301	**Compulsory :** Production Planning & Control	4	0	0	4	100	4
MAE 302	**Elective - IV :**	4	0	0	4	100	4
	A) Hydraulics and Pneumatics						
	B) Design of Equipments & Research Methodology						
	C) Automotive Maintenance & Management						
	Total of Theory						
Sessional							
MAE 381	**Dissertation (Part - I)**				24	100	4
MAE 382	Defense of Dissertation (Part - I)					100	8
	Total Credit of 3rd Semester				**32**	**400**	**20**

4th SEMESTER

Code	Subject	Contacts period per week				Full Marks	Credit
		L	T	P	Total		
Sessional							
MAE 481	Dissertation (Completion)				24	100	6
MAE 482	Post-Submission Defense of Dissertation					100	18
	Total Credit of 4th Semester				**24**	**200**	**24**
	Grand Total of Credits						**96**

M.Tech – Automotive Technology

Detailed Syllabus

1st Semester

MAE 101 - ADVANCED ENGINEERING MATHEMATICS
Contacts: 3-1-0
Credits: 4

Basic of Analysis: Elements of set theory, Set notions, open and closed sets, Application of set theory.

Complex Variables: Elements of set theory, Set notations, Applications of set theory, Open & Closed Sets. Review of Complex variables, Conformal mapping and transformations, Functions of complex variables, Integration with respect to complex argument, Residues and basic theorems on residues.

Matrix Operation: Solutions of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix eigen value and eigen vector problems.

Numerical Methods: Introduction, Interpolation formulae, Difference equations, Roots of equations.

Optimization Technique: Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus of variation, Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.

Probability and Statistics: Definition and postulates of probability, Field of probability, Mutually exclusive events, Bayes' Theorem, Independence, Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.

Reference Books:
1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill, 1997
2. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press 6th Edition, 1966
3. Conte, S. D.-Elementary Numerical Analysis: An Algorithmic Approach, Mc. Graw Hill. 3rd Edition, 1980
4. Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons. 11th Edition, 2004
5. Rao, S. S.- Engg. Optimization: Theory and Practice, N Age, 1996
6. Complex Variables: Introduction and Applications, Ablomitz & Fokus, Cambridge, 1998

MAE 102 - ADVANCED VEHICLE DYNAMICS
Contacts: 4-0-0
Credits: 4

Suspension : Requirements, dynamics of spring mass damper system, spring mass frequency. Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft direction. Hydraulic dampers and choice of damper characteristics. Independent, compensated rubber and air suspension systems. Roll axis and vehicle under the action of side forces.

Stability of Vehicles : Load distribution. Stability on a curved track and on a slope. Gyroscopic effects, weight transfer during acceleration and braking over turning and sliding. Rigid vehicle - stability and equations of motion. Cross wind handling.

Tyres : Types. Relative merits and demerits. Ride characteristics. Behaviour while cornering, slip angle, cornering force, power consumed by a tyre. Effect of driving, braking torque. Gough's tyre characteristics. Effect of camber, camber thrust.

Reference Books :
1. J. Y. Woung -Theory of Ground Vehicles, John Willey & Sons, NY
2. J. G. Giles -Steering, Suspension & Tyres, Illefe Books Ltd., London
3. W. Steed -Mechanics of Road Vehicles, Illefe Books Ltd. London
4. P. M. Heldt- Automotive Chassis, Chilton Co. NK

MAE 103 - ENGINE DESIGN
Contacts: 4-0-0
Credits: 4

Determination of engine power, Engine selection, swept volume, stroke, bore & no. of cylinders, Arrangement of cylinders stroke to bore ratio.

Design procedure of theoretical analysis, design considerations, material selection & actual design of components - cylinder block deign, cylinder head design, piston & piston pin design, piston ring design, connecting rod design, crankshaft design, flywheel design, design of valve mechanism

Engine balancing, firing order, longitudinal forces, transverse forces, pitching moments, yawing moments, Engine layout, major critical speed & minor critical speed, design of engine mounting, design of cooling system, design principles of exhaust & inlet systems,

Primary design calculation of major dimensions of fuel injection system.

Reference Books:

1. E. F. Obert - I. C. Engine & Air Pollution, Harper & Row Publishers, New York
2. Giles J. G.- Engine Design, Lliffe Book Ltd.
3. William Harry Crouse- Engine Design, Tata McGraw Publication, Delhi
4. V. L. Maleev - I.C. Engine, McGraw Hill Book, Co.
5. Lester C Lichty- I.C Engine, McGraw Hill, New York
6. SAE Handbooks

MAE 104 – ADVANCED AUTOMOTIVE ELECTRONICS

Contacts: 4-0-0
Credits: 4

Engine/Vehicle Sensors: Introduction, basic sensor arrangement, types of sensors, oxygen sensors, fuel metering/vehicle speed sensors, detonation sensor. Flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays.

Electronic Fuel Injection system: Introduction, feedback carburetor system (FBC), types of gasoline fuel injection system, Throttle body injection and multi port of point fuel injection, injection system control. Robert Bosch gasoline fuel injection system controls .Fuel air ration sensing .Turbo charged engine fuel system.

Electronic Ignition system: Advantages of electronic ignition system, principle of operation, high energy ignition distributors operation, simplified operational diagram for a distributor less ignition system, Electronic spark timing /control.

Digital engine control system : Open loop and close loop control system, engine cooling and warm up control, Acceleration, detonation and idle speed control-integrated engine system, exhaust emission control engineering, on-board diagnostics, diagnostics, future automotive electronic systems,

Warning and alarm instruments : Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, gear neutral indicator, horn design, permanent magnet horn, air & music horns.

Dash board amenities : Car radio and stereo, courtesy lamp, time piece, cigar lamp, car fan, wind shield wiper, window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination

Comfort and safety : seats, mirrors and sun-roofs, central locking and electronic windows, cruise control, in-car multimedia, security, airbag and belt tensioners, other safety and comfort systems, advanced comfort and safety systems, New developments in comfort and safety The system approach to control & instrumentation, Antilock breaking system (ABS).Electronic Ride-Microprocessor control.

Reference Books :
1.Robert N. Brandy- Automotive Computers & Digital Instrumentation, Prentice Hall Eaglewood, Cliffs, NJ
2.Wiliam B. Ribbens- Understanding Automotive Electronics, Allied Publishers Pvt. Ltd., Chennai.
3.Tom Denton- Automobile Electrical & Electronic Systems, Allied Publishers Pvt. Ltd., Chennai.

ELECTIVE-I

MAE 105A – COMBUSTION ENGINEERING
Contacts: 4-0-0
Credits: 4

Scope and history of combustion, Fuels, Thermodynamics of combustion, Chemical kinetics of combustion, rate of reactions, chain reactions, opposing reactions, consecutive reactions, competitive reactions, Conservation equation for multi component reacting systems,

Combustion Processes : Combustion in premixed and diffusion flames. Combustion process in I.C. Engines and Gas Turbines.

Combustion of gaseous & vaporized fuels, gas –fired furnace combustion, Premixed charge engine combustion, Detonation of gaseous mixture

Premixed laminar flames, Gaseous diffusion flames & combustion of a single liquid fuel droplet, Turbulent flames, combustion in two – phase flame systems, Chemically reacting boundary layer flows, Ignition

Heat of Reaction and Adiabatic Flame Temperature : Importance of heat of reaction. Constant pressure, constant volume combustion heat of reaction. Heat of reaction measurement.

Combustion of liquid fuels, spray formation & droplet behavior, Oil – fired furnace combustion, gas turbine spray combustion, direct injection engine combustion, detonation of liquid – gaseous mixture, combustion of solid fuels,

Reference Books :
1. Gary L. Borman, Kenneth W. Ragland - Combustion Engineering, McGraw Hill
2.Kenneth K. Kuo-Principles of Combustion, John Wiley & Sons
3. S. P. Sharma & Chander Mohan -Fuels & Combustion, Tata McGraw Hill
4. Samir Sarkar- Fuels & Combustion, Orient Longman, 3rd Edition.

MAE 105B – SOFT SKILL
Contacts: 4-0-0
Credits: 4

Introduction- An interactive session where both the student and the facilitator would exchange their views on the overall scope of the syllabus and the requirement to have such a practice lab in the curriculum. It would be a session of expectation setting by both the facilitator and the students about the goal of the course.

Etiquettes: Telephone Etiquettes, Email Etiquettes, Role Plays.

Presentation Skill: Elements of an effective presentation – Structure of a presentation – Presentation tools – Importance of tone pitch, voice modulation – Audience analysis – Body Language – Video Samples.

Group Discussion: Why is GD part of selection process? – Structure of a GD – Moderator-led and other GDs Strategies in GD – Team work – Body Language – Mock GD– Video Samples.

Personal Interview: Kinds of Interviews – Required Key Skills –Dress Code – Mock Interviews – Video samples, Role Plays.

Reference Books :
1.Meenakshi Raman and Sangeeta Sharma- Technical Communication.
R.C.Sharma and Krishna Mohan -Business Correspondence and Report Writing.
2.Norman Lewis -Word Power Made Easy
3.Prasad -How to prepare for Group Discussion & Interview (With Audio Cassette) ,TMH,2001.
4.Sasikumar- Spoken English – A self-learning guide to conversation practice(With Audio Cassette),TMH,1993.

MAE 105C - FINITE ELEMENT ANALYSIS
Contacts: 4-0-0
Credits: 4

Introduction : Basic concepts of FEM – Historical background, relevance and scope for FEM – need for approximation, weighted residual, Ritz and Galerkin method, variational, weak formation

General procedure of FEM : Discretization, interpolation, shape function, formulation of element characteristics matrices, assembly and solution

Formulation of element characteristic matrices and vectors for elasticity problems : One dimensional elasticity – two dimensional elasticity – three dimensional elasticity, axisymmetric elasticity

Formulation of element characteristics matrices and vectors for field problems, thermal

problems: one dimensional, two dimensional and three dimensional heat transfer – axisymmetric heat transfer– torsion problems.

Higher order and isoparametric formulations : Natural coordinates system and numerical integration – higher order one – dimensional, two – dimensional and three dimensional elements – structural beam, plate and shell elements- isoparametric elements – isoparametric formulation Computer Implementation: An overview of FE analysis program, preprocessing, solution, post processing.

Reference Books :

1. J. N. Reddy-An Introduction to the Finite Element Method, McGraw Hill
2. S. S. Rao- The Finite Element Method in Engineering, Pergaman Press.
3. M. J. Fagaan -Finite Element Analysis Theory and Practice, Longman Scientific and Technology.
4. R. D. Cook -Concept and Applications of Finite Element Analysis, John Wiley and sons Inc.
5. H. Kardestuncer -Finite Element Handbook
6. Rajasekaran- Finite Element Analysis in Engineering Design. Wheeler Publishing, New Delhi.
7. K. Bathe- Finite Element Procedures. Prentice-Hall of India (P) Ltd., New Delhi.
8. T R Chandrupatla and A D Belegundu- Introduction to Finite Elements in Engineering Prentice-Hall of India (P) Ltd., New Delhi.
9. O C Zienkiewicz- The Finite Element Method. Tata McGraw-Hill Publishing Co Ltd., New Delhi.

MAE 191 – AUTO ELECTRONICS LABORATORY

Contacts: 0-0-3
Credits: 2

1. Transducer's application
2. Electronics control
3. Micro-controller based system
4. A/D and D/A Converter
5. Simple data acquisition system

MAE 192 – AUTO COMPONENT DESIGN

Contacts: 0-0-3
Credits: 2

1. Designing automobile parts and assemblies using CATIA, PRO-Engineering like softwares.
2. Stress Analysis using software like ANSYS.
3. Manufacturing Simulation using software like DELMIA.

MAE 181 – SEMINAR - 1

Contacts: 0-2-0
Credits: 1

Seminar-I should be based on the literature survey on any topic relevant to Automobile Engineering (should be helpful for selecting a probable title of dissertation).

Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally – jointly.

Some marks should be reserved for the attendance of the student in the seminars of the others students.

2nd Semester

MAE 201 – INDUSTRIAL ROBOTICS
Contacts: 4-0-0
Credits: 4

Introduction:
History of robotics; Definition of robot; Main components of robot: manipulator, sensors, controller, power conversion unit; Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, jointed; Classification of robots according to coordinate system: Cartesian, cylindrical polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications: payload, accuracy, repeatability, resolution,maximum tip speed, reach, stroke;

Robot End Effector
End effector: definition, gripper, tools; Gripper : main parts, source of power; Types of grippers: mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers, hooks , scoops, ladles; Universal gripper; Robot Tools: spot welding gun, pneumatic impact wrench, pneumatic nut runner, stud-welding head, inert gas welding torch, heating torch, grinder, spray painting gun.

Robot Actuators:
Definition, Characteristics: power to weight ratio, stiffness, compliance, reduction gears; Conventional actuators: hydraulic actuator, pneumatic actuator, electric motor, direct drive motor, stepper motor; servo motor, Special actuators: magnetostrictive, shape memory, alloy, elestomer, Mc Kibben artificial muscle;

Robot Sensors:
Definition of Sensor and transducer; Calibration; Basic categories of measuring devices: analog, discrete; Main types of sensors: position, velocity, acceleration, force and pressure, torque, touch and tactile, proximity, sniff, vision, voice recognition.

Robot Vision:

Definition of digital image, generation of digital image; Robot Vision System: definition, use, functions, components, classification, vision cameras; Techniques of image processing and analysis: Image data reduction, segmentation, feature extraction, object recognition; Application of robot vision system.

Robot Kinematics:
Definition of Robot kinematics, Tool frame and base frame. World –coordinate system, Direct kinematics,Inverse kinematics, Describing position and generation of a point in space, Derivation of rotational matrix by different methods, Homogenous transformation, Denavit- Hertenberg representation.

Robot Programming:
Definition of robot programming; Different methods of robot programming: teach-pendant programming,key board programming; Programming languages: VALII, AML/2, ARM BASIC.

Industrial Application of Robots & Safety:
Material Transfer; Machine loading and unloading, Processing operations, Assembly operations, Inspection.Safety measures in robotic area.

Reference Books :
1. Klafter, Richard D. Chmielewaski, Thomas A. and Negin, Michael - Robotic Engineering, Prentice-Hall of India Pvt. Limited. (2001)
2. Groover, Mikell P. Weiss, Mitchell., Nagel, Roger N., Odrey, Nicholas G.– Industrial Robotics : Technology, Programming and Applications, McGraw-Hill International Edition(1986)
3. Niku, Saeed B- Introduction to Robotics Analysis, Systems, Applications, Prentice Hall of India Private Limited, New Delhi. (2001)
4. Shilling , Robert J. - Fundamentals of Robotics : Analysis & Control, Prentice Hall of India, New Delhi(1990)
5. Koren, Yoram - Robotics for Engineers, McGrew-Hill Book Company, Sinagapore (1987)
6. Hall, Ernest L. Hall Bettie C. - Robotics: A User-Friendly Introduction, Holt, Rinehart and Winston, Holt-Saunders, Japan (1985)
7. Yoshikawa, Tsuneo Foundations of Robotics: Analysis and Control, Prentice Hall of India Private Limited, New Delhi (1990)
8. Mason, Matthew T., Mechanics of Robotic Manipulation, Prentice Hall of India Private Limited, New Delhi (2005)
9. Fu, Lee. Gonzakz, Robotics: Control, sensing, vision, intelligence, Mc. Graw Hill,New York

MAE 202 – AUTOMATION AND FLEXIBLE MANUFACTURING SYSTEMS

Contacts: 4-0-0
Credits: 4

Introduction to automation: Manufacturing automation, production facility, plant layout; production concepts and mathematical models, basic elements of an automated system, levels of automation

GT: Group Technology, different approaches of grouping – PFA Chart; Rank order clustering, part classification and Coding system, composite part, different GT machine cells and layout , From-To chart.

FMS: Comparison between automated GT and FMS, level of flexibility, Classification, different components, benefits, cutting tool management system in FMS.

Manual assembly lines: Assembly line design, Line balancing algorithms.

Automated production lines: Transfer lines, fundamentals and design of automated assembly systems.

Computer aided machining: Introduction to Numerical control, Advantages and application, CNC (open loop and closed loop), DNC and Adaptive control, Components of NC and CNC machine tool, Manual programming for lathe and Computer-Assisted Part Programming using APT.

CIM: Introduction, Functional classification of CIM database, Communication network in CIM, advantages.

Computerised manufacturing planning systems: Process planning, production planning, material requirement planning, capacity planning, shop floor control, factory data collection system, automated identification systems, bar code technology, automated data collection systems.

Reference Books :

1. M.P. Groover- Automation, Production Systems and Computer, Integrated Manufacturing , PHI
2. Yoram Koren- Computer control of manufacturing systems, McGraw Hill Publishing Company
3. T.K. Kundra, P.N. Rao, N.K. Tiwari- Numerical Control and Computer Aided Manufacturing, Tata McGraw Hill
4. S.R.Deb- Robotic Technology and Flexible Automation, Tata McGraw Hill

MAE 203 – AUTOMOTIVE MATERIALS

Contacts: 4-0-0
Credits: 4

Advance Metallic Material: Micro-alloy steel **(**DP, TRIP, IF), classification, application and development **Composite Material:** classification, properties, fabrication process, stress-strain relationship, failure analysis, application and modern development

Ceramic Material:

Crystal Structures, Silicate Ceramics, Carbon, Imperfections in Ceramics, Diffusion in Ionic Materials, Ceramic Phase Diagrams , Brittle Fracture of Ceramics ,Stress–Strain Behavior Mechanisms of Plastic, Deformation , Ceramics , Clay Products, Refractories , Abrasives, Cements, Advanced Ceramics fabrication and Processing of Glass sand Glass–Ceramics, Fabrication and Processing

Polymer Material : Classification, properties, processing and synthesis, mechanical behaviour and application.

Energy material: Fossil fuel, solar cell, semiconductor materials, Lithium battery, nuclear material etc.

Nano-material : Introduction to phase transformations and microstructural control on the nanometre scale, Production techniques for inorganic nanoparticles and nanomaterials. Microstructural stability in nanomaterials. Chemical and mechanical properties of inorganic nanomaterials and microstructure-property relationships. Case studies in controlled synthesis

Reference Books :

1. Edited by B. Bhushan- Handbook of Nanotechnology, 2nd Edition, Springer, 2007.
2. William F. Smith-Principles of Materials science & Engineering, McGraw Hill (1999).
3. William F. Smith- Fundamentals of Materials science & Engineering, McGraw Hill (1999).
4. L.H. van Vlack- Elements of Materials science & Engineering, Addison-Wesley
5. Eds. R W Kelsall, I W Hamley and M Geoghegan- Nanoscale Science and Technology, published Wiley, 2005.
6. Edited by W. A. Goddard, D. W. Brenner, S. E. Lyshevski, G. J. Iafrate- Handbook of Nanoscience, Engineering and Technology, CRC Press, New York 2003.
7. Edited by J. H. Fendler -Nanoparticles and Nanostructured Films, Wiley-VCH, New York 1998.
8. Edited by H. S. Nalwa- Nanostructured Materials and Nanotechnology (concise edition), Academic Press, New York 2002.

ELECTIVE-II

MAE 204A – AUTOMOTIVE EMISSION & ALTERNATIVE FUELS

Contacts: 4-0-0
Credits: 4

Engine Basic Theory: Engine types and their operation, classification, Properties of I.C. engine fuels, Actual cycle, air fuel cycle, combustion charts (Equilibrium), Two stroke engines, four stroke engine, characteristics of engines, air capacity of engine, valve timing diagram, supercharging, MPFI, VVT, cam less engine.

Fuel Supply, Ignition, Cooling and Lubrication Systems : Theory of carburetion and carburetors, mixture distribution, petrol injection, diesel fuel injection pumps, conventional and electronic ignition systems for SI engines, air cooling and water cooling, design aspects, forced feed lubrication system.

Air Motion Combustion and Combustion Chambers : Swirl and turbulence – swirl generation, combustion in SI & CI engines, flame travel and detonation, Ignition delay,. Knock in CI engines, combustion chamber design

M.Tech – Automotive Technology

Air Pollution due to Automobile Exhaust : Sources of Emission, Exhaust gas constituents & analysis, Ingredients responsible for air pollution, Smoke, odor, Smog formation.

Engine combustion and pollutant formation: HC, CO, NOx, Particulate matters, Aldehde emissions, Effect of operating variables on emission formation.

Exhaust Emission Control: Basic method of emission control, catalytic converter, After burners, reactor manifold, air injection, crank case emission control, evaporative loss control, Exhaust gas recirculation, Fuel additives, thermal reactors.

Pollution Norms : European pollution norms, Indian pollution norms as per Central Motor Vehicle Rules (C.M.V.R.).

Instrumentation for Exhaust Emission Measurement: Measurement procedure, Sampling Methods, Orsat Apparatus, Infrared Gas analyzer, Flame Ionization Detector (FID), Smoke meters.

Test procedure & instrumentation for emission measurement: Test procedures –Measurements of invisible emissions-ORSAT apparatus, NDIR analyzer, Flame ionization detectors, Chemiluminescent analyzer, Gas analyzer, Measurements of visible emissions- Comparison methods & Obscure methods –Smoke meters, Emission standards.

Stratified Charged, Low heat rejection engine, Sankey plot, four / three valve engine, OHC engine, governing of automobile engine, New engine technology, Recent developments in I. C. engines

Alternate Fuels: Estimation of petroleum reserve-need for alternate fuels-merits & demerits and uses of CNG, LPG, Alcohols, Hydrogen, bio-fuels, electric energy, solar energy.

Reference Books :

1. Richard Stone- Introduction to Internal Combustion Engines, McMillan, London
2. Hein Heister - Vehicle and Engine Technology
3. Hein Heister- Advance Vehicle Technology
4. E. F. Obert,- I. C. Engine & Air Pollution, Harper & Row Publishers, New York
5. C. Fayette Taylor & Edward S. Taylor- I. C. Engines, International text book com.
6. V. L. Maleev - I.C. Engine, McGraw Hill Book, Co.
7. Ferguson -I. C. Engines
8. Charles A. Fisher- S. I. Engine – Fuel Injection Development, Chapman & Hall
9. Herbert E. Ellinger- Automotive Engines
10. Automobile Engg. Volume – I, American Technical Society, Chicago
11. John B. Heyhood- Internal Combustion Engines Fundamentals, McGraw Hill

MAE 204B – FLUID DRIVES AND CONTROL
Contacts: 4-0-0
Credits: 4

Introduction to fluid power

Classification of fluid power

Energy and power in Hydraulic Systems : Application of Pascal's law, Conservation of energy, the continuity equation, hydraulic horse power, Bernonll's equation, energy, power and flow rate in the SI Metric System.

The source of hydraulic power: Pumps, Pumping theory, pump classification – Gear, vane, piston, pump performance, pump noise, pump selection.

Linear Actuator (Hydraulic Cylinder) : Overall operating features, cylinder mountings and mechanical linkages, cylinder force, velocity and power, cylinder cushions, mechanics of hydraulic cylinder loadings, telescopic cylinder, design aspects.

Rotary Actuator (Hydraulic Motor) : Classification: Gear, Vane, Piston; hydraulic motor theoretical torque, power and flow rate, hydraulic motor performance.

Valves and other control components in hydraulic systems : Direction control valves, pressure control valves, flow control valves, cartridge valves, pressure and temperature switches, hydraulic accumulators, pressure intensifiers, servo valves.

Hydraulic Conductors and Fittings : Conductor sizing, pressure ratings of conductors, steel pipes, steel tubing, plastic tubing, flexible hoses,quick disconnect couplings, metric size tubing.

Hydraulic Circuit Design and Analysis : Control of a single acting hydraulic cylinder, control of a double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, pressure intensifier circuit, sequencing circuit, cylinder synchronization circuit, fail-safe circuit, speed control of hydraulic cylinder and hydraulic motor, hydrostatic transmission systems, analysis of hydraulic system with fictional losses, accumulator circuits.

Components of Pneumatic Systems : Properties of air, the perfect gas laws, compressors, fluid conditioners, air control valves, pneumatic actuators.

Pneumatics: Circuit and Applications : Pneumatic circuit design considerations, air pressure losses in pipelines, simple multicylinder circuits, emergency stop circuits, emergency stop circuits, fail-safe circuits, two-handed control, cascade circuits, cascade circuit design procedure, group selection and stepper circuits.

Electrical Controls for Fluid Power Circuits : Electrical components, limit switches, solenoids, control of a cylinder using a single limit switch, reciprocation of a cylinder using pressure or limit

switches, dual cylinder sequencing circuits, electrical control of a regenerative circuit, electro hydraulic servo system, application of Programmable Logic Controller (PLCs) in fluid power circuits.

Introduction to Fluidics : Principles of fluids logic control, basic fluidic devices, fluid sensors, fluidic control of fluid power systems.

Reference Books :

1. Authony Esposito- Fluid power with applications, Prentice Hall International, Inc
2. S.R. Majumdar- Oil Hydraulics, Tata Mc Graw Hill
3. S.R. Majumdar- Pneumatic System: Principles and Maintenance, Tata Mc Graw Hill
4. D.D. Banks, D.S.Banks- Industrial Hydraulics, Prentice Hall
5. A.B.Goodwin- Power Hydraulics, B.I. Publications
6. Chris Stacey- Practical Pneumatics, Arnold Publication

MAE 204C - NOISE & VIBRATION

Contacts: 4-0-0
Credits: 4

Noise : Noise characteristics, Sources of noise, noise level measurement techniques, vehicular noise level, engine noise, transmission noise, brake squeal, structural noise, noise in auxiliaries, wind noises etc.

Noise Testing & Noise Control : Mechanization of noise generation, noise control methodologies, noise control measures, environmental noise management.

Road vehicle noise standards :

Vibration: Introduction, Single degree of freedom, damped, forced vibration, Multi degree of freem vibration, modes, nodes, Holzer's method.

Multi degree of freedom of vibration : Matrix method, eigen values and vectors, natural frequencies & modes, model analysis, numerical methods for solution, Lagrange's equation for problem formulation, Two degree of freedom system, co-ordinate, coupling, solution.

Vibration under periodic force, use of Fourier series :

Vibration of continuous systems, transverse vibration of cable, bar, torsion vibration of shaft, Rayliegh's method, Reyliegh-Ritz method.

Vibration control, Balancing of reciprocating & rotating masses, controlling natural frequencies, vibration isolation, vibration absorbers.

Basics of non-linear vibration, causes of non-linearity, formulation, solution methods, iterative, graphical, methods of isoclines, stability of equilibrium state, types of singularity, limits cycle.

Basic vibration measuring set up, brief introduction to experimental model analysis.

Reference Books :

1. S. S. Rao- Mechanical Vibration, New Age International (P) Ltd., New Delhi
2. I. H. Shames- Engineering Mechanics Static & Dynamics
3. P. Srinivasan- Mechanical Vibration Analysis, Tata McGraw Hill Pub. New Delhi
4. P. Srinivasan- Non-linear Mechanical Vibration, Tata McGraw Hill Pub. New Delhi
5. S. Graham Kelly- Fundamental of Mechanical Vibration, Tata McGraw Hill Pub.
6. Grover G. K.- Mechanical Vibration, Nem Chand & Brothers, Roorkee
7. Daniel J. Inman- Engineering Vibration, Prentice Hall, NJ
8. W. T. Thomson-Theory of Vibrations, CBS Publishers, New Delhi
9. S. P. Singal, Noise- Pollution & Control, Narosa Publishing House, New Delhi

ELECTIVE-III

MAE 205A - MATERIALS HANDLING SYSTEM

Contacts: 4-0-0
Credits: 4

Introduction to Materials Handling: Definition, scope and importance of Materials Handling; System concept; Classification and characteristics of materials.

Principles of Materials Handling : Significance of Materials handling principles; Different principles and suggestions for their application.

Unit Load Concept: Advantages and disadvantages; Load unitization processes; Pallets, skids & containers; Packaging for Materials Handling.

Classification of Materials Handling Equipment:

Industrial Vehicles / Trucks: Hand trucks; Power trucks; Forklift trucks and attachments.

Conveyors: Belt Conveyors – characteristics, types, components, basic design considerations; Chain Conveyors –characteristics, types, components, aspects of design; Roller Conveyors- characteristics, types,components, aspect of design; Screw conveyors – characteristics, types, components, aspects of design.

Pneumatic & Hydraulic Conveyors:

Hoisting Equipment: Hoists; Winches; Elevators – types and parts of hoisting equipment, design considerations, Cranes : wharf cranes, level buffing system, Derricks.

Robotic Handling : Materials handling at workplace; Types of robots; Robotic handling applications; AGV.

Auxiliary Equipment : Gates; Feeders; chutes; Positioners; Weighing and control equipment.

Organisation, Maintenance & Safety:

Reference Books :
1. Apple, J.M -- Material Handling System Design, John Wiley & Sons
2.Allegri,T.H- Materials Handling: Principles and Practice, CBS Publishers & Distributors, N.Delhi
3. J.R, Immer- Materials Handling, McGraw Hills
4. Spivakovsky, A and Dyachkov,V- Conveyors and Related Equipment, Peace Publishers, Moscow
5. Rudenko N.- Materials Handling Equipment, Peace Publishers, Moscow
6. Alexandrov, M.P- Materials Handling Equipment, Part-I and II, Mir Publishers, Moscow
7. Ray, T.K.- Mechanical Handling of Materials, Asian Books Private Ltd., 2004
8. Ray, S.- Introduction to Materials Handling, New Age International Publishers, 2008.

MAE 205B – VEHICLE DESIGN

Contacts: 4-0-0
Credits: 4

Selection of materials for various pattern of duty and factor of safety as per specification of SAE.

Gear box: Gear train, input, output and lay shaft. Gear body, bearings with heat dissipation, gear casing.

Steering: Collapse able and other type, steering wheel, steering column, rack & pinion, sector gear, tie rod.

Clutch: Clutch plate, cushion spring, torsion spring, clutch paddle, liver.

Suspension: Spring design, shock absorber and other components.

Differential: Sun gear, planet gear, ring gear arm.

Reference Books :
1. Patil S.P.- Mechanical System Design.
2. Madhaban K,and Reddy K.V. - Design data handbook, CBS Publication
3. De.A.- Automobile Engineering, Galgotia Publication

MAE 205C – TRIBOLOGY

Contacts: 4-0-0
Credits: 4

Introduction: Introduction of Tribology – General tribological considerations in the design of bearings, gears, cams, reciprocating components, etc.

Engine Tribology : Basics, - tribology / aspects of engine components such as bearings, piston assembly, valve train and drive train components etc.

Friction: Natural of metal surfaces – Surface properties – Surface parameters and measurements. Friction – Sliding friction – Rolling friction characteristics of common metals and non-metals – friction under environments. Engine friction – Losses and engine design parameters.

Wear: Economic role of wear – type of wear- wear mechanism, factors affecting wear, selection of materials for different wear situations, measurement of wear, tribometers and tribometry. Engine wear, mechanisms, wear resistance material and coatings and failure mode analysis.

Bearings and Lubrication : Lubricants, type of lubricants, properties and testing, service classification of lubricants, lubrication of tribological components, lubrication system, lubricant monitoring, SOAP, ferrography and other rapid testing methods for lubricants contamination.

Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, generalized Reynolds equation, slider bearings, fixed & pivoted shoe bearings, hydrodynamic journals bearings, short and finite bearings, thrust bearings, sintered bearing, non-circular bearings and multi side surface bearings.

Externally (Externally – pressurized) lubrication: Hydrostatic bearing, basic concepts, bearing pads, coefficients, restrictors, capillary, orifice and flow control valve, bearing characteristics number and performance coefficients, flat, conical and spherical pad thrust bearing, multi-recess journal and thrust bearings, air and gas lubricated bearings.

Elasto – hydrodynamic lubrication : Ball and roller element bearings, classification, selection and life estimation, fatigue, monitoring of ball / roller bearings, diagnostics.

Rheodynamics (Static) lubrication: Non-Newtonian fluids, characteristics, general recommendations of lubricants, SAE & other cloud numbers, thixotopic, materials and Bingham solids, grease lubrication and care stability, tribology components in extreme environments like vacuum, pressure, temperature, tribology matching and selection, tribolo-testing and standards.

Reference Books :

1. Bowden F.P. & Tabor D.- Friction and Lubrication, Heinemann Edu. Books Ltd. 1974
2. Ernest Rabinowiez,- Friction & Wear of Material
3. Neal M.J Butterworth- Tribology – Handbook., 1973
4. O'Connor J.J. & Boyd J.- Standard hand Book of Lubrication Engg., McGraw Hill, 1968.
5. Pinkus O & Sternlincht B- Theory of Hydro-dynamic Lubrication, McGraw Hill, 1961.
6. Fuller D.D.- Theory & Practice of Lubrication of Bearing, McGraw Hill, 1947.
7. Shaw M. C., Macks F.- Analysis & Lubrication of Bearings, McGraw Hill, 1947
8. Stansfield F.- Analysis & Lubrication of Bearings for Machine Tools and Similar Applications, Machinery Publishing, 1970
9. B. C. Muzumdar - Tribology,

MAE 291 – CAD-CAM LABORATORY
Contacts: 0-0-3
Credits: 2

1. Experiments to demonstrate the features of CNC machines, CNC programming on turning and milling machines.
2. Study of the geometry of the robot manipulators, actuators, grippers, and experiments on robot programming and simple sensor experimentation.
3. Demonstration of basic CAD-CAM systems, generation of tool path from product geometry using CAD-CAM simulation tools.
4. Robot simulation modelling.

MAE 281 - SEMINAR - II
Contacts: 0-2-0
Credits: 1

Seminar - II shall be based on tentative topic on dissertation such as review paper on some specific well defined area/specialized stream of automobile engineering

Each student has to prepare a write up of about 25 pages of "A4" size sheets and submit it in duplicate as the term work.

The student has to deliver a seminar talk in front of the faculty members of the department and his classmates. The faculty members, based on the quality of the work and preparation and understanding of the candidate, shall do an assessment of the seminar internally – jointly.

Some marks should be reserved for the attendance of the student in the seminars of the others students.

MAE 282 – COMPREHENSIVE VIVA-VOCE
Credits: 4
Viva-voce examination will be based on the fundamental questions and practical applications on the subjects taught.

3rd Semester

MAE 301 - PRODUCTION PLANNING AND CONTROL
Contacts: 4-0-0
Credits: 4

Organisation, organisational structure, types of organisation structure, multi-plant organisation.

Production, Types of Production System and its element, Generalized model Production System.

Products and Services, Design & Development.

Forecasting: Importance the marketing interface, the materials interface, Basic Techniques.

System Economics: Tactics & Strategies, Break-Even-Analysis, Life Cycle analysis and capacity planning.

The plant or facilities : Location and design of the plant or facilities, Layout of the facilities, Equipment selection.

Maintenance of the facilities and equipment.

Material and Inventory Management
Demand analysis, Resource Planning, Aggregate Production Planning, Line Balancing.

Materials requirement planning, Sequencing and Scheduling.

Human Factors, Manpower planning, Placement, Training, Motivation, Safety.

Production Monitoring and Control, Performance Criteria and evaluation, Case Studies and Example.

Reference Books :
1. E. S. Buffa- Production and Operations Management, New Age International (P) Ltd., New Delhi.
2. J. L. Riggs- Production Systems: Planning, analysis and Control, John Wiley & Sons, New York.
3. S. N. Chary-Production and Operations Management, Tata McGraw-Hill Publishing Co. Ltd., New Delhi

ELECTIVE-IV

MAE 302A – HYDRAULICS AND PNEUMATICS
Contacts: 4-0-0
Credits: 4

Introduction: Power hydraulics & its applications, Hydraulic symbols,

Positive displacement Pumps: Gear, Vane, Piston and other special types of pumps.

Control valves: Pressure Control: relief valve, Unloader valve, Pressure reducing valve, Counter balance valve, sequence valve, Flow Control: Meter in Meter out, Bleed off, Pressure and Temperature compensated flow control valve, Direction Control: Check valve, 2/3 position, ¾ position, Open centre, closed centre, Tandem centre and others, Cartridge valves, Flow forces on valve spools and valve design.

Hydraulic actuators: Linear (S/T, D/T, Cushion) and rotary, Design of Hydraulic actuators, Accessories in hydraulic systems: Accumulator, Air-breathe valve, Pressure switches etc. Hydraulic power packs.

Servo valves: Torque motor, electro-hydraulic Servo valves: Types and principles of operations.

Design of Hydraulic circuits and its application: Regeneration, Pre-fill, Twin Pump and others.

Maintenance of hydraulic systems and working fluid:

Pneumatics: Air Filter, Lubricators and Regulators, Pneumatic control elements: Air Cylinders and their Design, Pneumatic safety circuits, Pneumatic Logic control.

Fluidics:

Reference Books :

1. H.E. Merritt- Hydraulic Control Systems, Wiley New York.
2. Esposito- Fluid Power , Peaerson Education
3. Andrew Parr- Hydraulics and Pneumatics, Jaico Publishers.

MAE 302B- DESIGN OF EQUIPMENTS & RESEARCH METHODOLOGY

Contacts: 4-0-0
Credits: 4

Research Concepts: Meaning, objectives, motivation, type of research, approaches, research (descriptive research, conceptual, theoretical, applied and experimental).

Formation of Research Task: literature review, importance and methods, sources, quantification of cause-effect relations, discussions, wheel study, laboratory experiments, critical analysis of already generated facts, hypothetical proposal for future development and testing, selection of research task, prioritization of research.

Mathematical Modeling and Simulation: concept of modeling, classification of mathematical models, modeling with ordinary differential equations, difference equations, partial differential equations, graphs, simulation: concept, types (quantitative , experimental, computer, fuzzy theory, statistical) processes of formulation of model based on simulation.

Experimental Modeling:

a) Definition of experimental design, examples, single factor experiments blocking and Nuisance factors, guidelines for designing experiments.

b) General model of process: I/P factors/ variables, O/P parameters /variables controllable/ uncontrollable variables, dependent/independent variables, experimental validity.

c) Process optimization and design experiments methods for study of response surface, first order design, determining optimum combination of factors, method of steepest ascent, Taguchi approach to parameter design.

Analysis of results (parametric and nonparametric, descriptive and inferential data): types of data, collection of data (normal distribution, calculation of co relation coefficient) data processing, analysis, error analysis, meaning, different methods: analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity/nonlinearity of model, testing adequacy of model. Testing model / hypothesis, use of computational tools, software for research work.

Report writing: types of report, layout of research report, interpretation of results, style manuals, layout and format, style of writing, typing, references, paginations, table, figures, conclusions, appendices, writing research paper for publication based on dissertation / research work.

Landscape of Creativity: convergent vs divergent thinking, creativity, creativity vs intelligence, creativity abilities, creativity and madness, determination of creativity, increasing creativity, creativity achievements, techniques of creativity, collective creativity.

Reference Books :

1. Willkinsion K.P. L., Bhandarkar-Formulation of Hypothesis, Himalaya publishing, Mumbai.
2. Schank Fr-Theories of Engineering Experiments, Tata McGraw Hill.
3. Douglas Montgomary-Design of Experiments
4. Introduction to SQC, John Willy & sons.
5. Cochran & cocks-Experimental Design, John Willy & sons.
6. John W. Besr and James V. Kahn-Research in Education, PHI publication.
7. Adler and Granovky-Optimization of Engineering Experiments, MIR Publications.
8. S. S. Rao-Optimization Theory & Applications, Wiley Estern Ltd. ND.
9. C. R. Kothari-Research Methodology, Willy Estern Ltd. ND.
10. P. D. Kulkarni-Independent Study Techniques, TTTI Chandigardh

MAE 302C - AUTOMOTIVE MAINTENANCE & MANAGEMENT

Contacts: 4-0-0
Credits: 4

Maintenance records and schedule: Importance of maintenance with different types, maintenance records, factors considered for design & development of modern service garages / dealers shops, different garage layouts.

Engine Maintenance: Engine troubles, effects & remedies, different major & minor services for engine, inspection and checking of components visually and dimensionally, reconditioning methods of engine components, engine tune-up, special tools & advanced equipments.

Chassis Dive-line Maintenance: Maintenance, repair and servicing of clutches, Fluid flywheel, gear boxes, Automatic transmission ,CVT unit, propeller shaft, differential unit, front axle and rear axle, suspension systems, servicing of brake systems- hydraulic, air systems, brake bleeding and brakes

adjustments, maintenance and servicing of steering system-Manual & Power Steering system, wheel balancing, wheel alignment, maintenance of tyres, tyre rotation, frame defects, chassis frame alignment.

Maintenance, servicing of auxiliaries: Cooling system service, anti corrosion additives, anti freezing solutions, dry & wet liners, Petrol fuel and diesel fuel system maintenance, MPFI maintenance, lubrication system services, Chassis lubrication, lubrication chart, maintenance and care of storage batteries, battery testing methods, maintenance of ignition systems, tyre service & reconditioning.
Maintenance & repair of vehicle body: Passenger comfort parameters, body coach work, window rattling, noise & vibration, body repair tools & equipments, polishing and painting of new and old vehicle body

Reference Books :
1. W. Steed-Mechanics of Road Vehicles, Illefe Books Ltd. London
2. P. M. Heldt- Automotive Chassis, Chilton Co. NK
3. Lester C Litchy- I. C. Engine , McGraw Hill New York
4. Obert –I. C. Engine
5. Richard Stone- Introduction to Internal Combustion Engines, McMillan, London
6. Hein Heister- Vehicle and Engine Technology
7. Hein Heister - Advance Vehicle Technology
8. Charles A. Fisher -S. I. Engine – Fuel Injection Development, Chapman & Hall
9. Herbert E. Ellinger- Automotive Engines
10. Automobile Engg. Volume – I - American Technical Society, Chicago
11. John B. Heyhood- Internal Combustion Engines Fundamentals,McGraw Hill

MAE 302D – MODELING OF DYNAMICAL SYSTEMS
Contacts: 4-0-0
Credits: 4

Introduction: An invariant nature of power exchange, Power variables of bond graphs, Bond graphs for simple electrical circuits, Representation of junction elements, Reference power directions on the bonds, Bond graph standard elements, Power directions and physical system co-ordinates.

Notion of Causality: The notion of causality, Causality of sources, Causality of I and C elements, causality of R element, Causality of junction elements, Causality of two –port element, Differential causality, Algorithm for assigning casulity.

Creation of System Equations: Selection of system states and generation of system equations, A bond graph with a transformer element, Electrical systems, Systems with differential casuality, Activation and activated bonds, System equation of motion with field elements.

Creation of system Bond Graph: Guide line for creating systems bond graphs, Bond graphs for mechanical systems, Bond graphs of electrical circuits model of an electrical transformer, Gyarator and transformer equivalence, Model of a basic induction motor , Model of a 2- pole DC motor, Bond graph of a 3- Phase induction motor.

Use of Non Inertial Co Ordinates: Introduction, Principle of material objectivity, Mapping back to inertial frame, A pre analysis of rate of change of generalized moment, Dynamics of rigid bodies, Another look at the objectivity of complement fields.

Structural Members: Introduction, Euler- Bernoulli beam model, Rayleigh beam model, modeling of a beam column, Timoshenko beam model, Modal bond graph for continuous systems, Transverse vibration of a uniform beam under transverse loads and moments.

Modeling of Multi-body Systems : Introduction , modeling of mechanism, Modeling of mechanical handling systems , modeling and computation of driving efforts for online control .

Modeling of Thermal Systems : Introduction, The thermal C- field for a volume of gas, Thermodynamic relations for C-field for an ideal gas, Modeling the thermal interface , Modeling the material interface , Interface through finite resistor , Pseudo bond graph for heat transfer and concept of derived bond graphs (DBG) ,

Approaching Control Systems: Signal – Flow Graph from bond graph, Applications of bond graphs to control systems , Position control of a mass on a spring-damper combination , Proportional control , Proportional-integral control , Proportional-integral-derivative control, velocity control of moving cars connected by a spring.

Control Strategies in Physical Domains: Introduction, Physical equivalence, control system design from physical stand point as an inverse problem, Robust overwhelming control skill, Impedance control, Physical system transpositioning in the bond graph space, Implication of asymmetric transpositions.

Reference Books:

1. Amalendu Mukherjee , Ranjit Karmakar and Arun Kumar Samantaray – Bond graphs in modeling , Simulation and Fault identification Published by I. K . International Publishing House Pvt. Ltd., 2006 & also in CRC Press Talyor & Francis Group

2. Shuvra Das – Mechatronic Modeling and Simulation Using Bond Graphs, Published by CRC Press Talyor & Francis Group, 2009.

3. Ronald C. Rosenberg , D.C. Karnoop & Margolish – Introduction To Physical system Dynamics Published by McGraw – Hill college, 1983.

4. F. T .Brown - Engineering System Dynamics, Published by CRC Press Talyor & Francis Group.

MAE 381 – DISSERTATION (PART- I)
Contacts: 24 periods per week
Credits: 4

The term work under this, submitted by the student shall include –

1. Work diary maintained by the student and counter signed by his guide.

2. The contents of work diary shall reflect the efforts taken by candidate for –

   (a) Searching the suitable project work
   (b) Visits to different factories or organizations
   (c) Brief report of journals and various papers referred
   (d) Brief report of web sites seen for project work
   (e) The brief of feasibility studies carried to come to final conclusion
   (f) Rough sketches
   (g) Design calculation etc. etc. carried by the student.

The student has to make a presentation in front of panel of experts in addition to guide as decided by departmental head.

MAE 382 – DEFENCE OF DISSERTATION (PART – I)
Credit : 8

Viva voce of the project will be based on the project thesis to be conducted at the end of the 3rd Semester.

4th Semester

MAE 481 – DISSERTATION (COMPLETION)
Contacts: 24 periods per week
Credits: 6

The dissertation submitted by the student on topic already approved by university authorities on the basis of initial synopsis submitted by the candidate shall be according to following guidelines –

Format of dissertation report –
The dissertation work report shall be typed with double space on A4 bond paper. The total number of pages shall not be more than 150 and not less than 60. Figures, graphs, annexures etc. be added as per requirement. The report should be written in the following format.

1. Title sheet
2. Certificate
3. Acknowledgement
4. List of figures / photographs / graphs / tables
5. Abbreviations
6. Abstract / final synopsis
7. Contents
8. Text with usual scheme of chapters
9. Discussion of the results and conclusion
10. Bibliography (The source of illustrative matter will be acknowledged clearly at appropriate place)

MAE 482 – POST-SUBMISSION DEFENSE OF DISSERTATION

Credit : 18

Viva voce of the project will be based on the project thesis to be conducted at the end of the 4^{th} Semester.