UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VII SEMESTER

MECHANICAL - STREAM - AUTOMOBILE ENGINEERING

SCHEME -2013

VII SEMESTER

MECHANICAL - STREAM - AUTOMOBILE ENGINEERING (U)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/P				
13.701	Principles of Management and Decision Modeling (MPU)	3	2	1	-	50	3	100	150
13.702	Mechatronics (MPSU)	4	3	1	-	50	3	100	150
13.703	Automotive Air Conditioning Systems (U)	4	4	-	-	50	3	100	150
13.704	Engine and Drive Line Design (U)	4	3	1	-	50	3	100	150
13.705	Modern Automotive Technology (U)	4	4	-	-	50	3	100	150
13.706	Elective III	4	3	1	-	50	3	100	150
13.707	Vehicle Reconditioning lab (U)	2	-	-	2	50	3	100	150
13.708	Mechatronics Lab (U)	2	-	-	2	50	3	100	150
13.709	Project and Project Seminar (MNPSU)	2	-	-	2	100	-		100
	Total	**29**	**19**	**4**	**6**	**500**		**800**	**1300**

13.706 Elective III

13.706.1	Plant Engineering & Maintenance (MPU)
13.706.2	Fracture Mechanics (MPU)
13.706.3	Entrepreneurship Development (MPU)
13.706.4	Finite Element Methods (MPU)
13.706.5	Metal Forming (MPU)
13.706.6	Non-Conventional Machining Techniques (MPU)
13.706.7	Experimental Methods In Engineering (MPU)
13.706.8	Mechanical Vibration & Noise Control (MPU)
13.706.9	Failure Analysis (MPU)
13.706.10	Industrial Automation (MPU)
13.706.11	Vehicle Performance And Testing (U)
13.706.12	Automotive Aerodynamics (U)
13.706.13	Tractors & Farm Equipments (U)

13.701 PRINCIPLES OF MANAGEMENT AND DECISION MODELING (MPU)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

The main objectives of this course are

- *To understand evolution of scientific management and principles of management in organizations.*
- *To understand different types of industrial ownerships and organizational structures.*
- *To learn the methods and techniques to effectively manage human resource in an organization.*
- *To understand various quantitative techniques in decision making.*

Module – I

Evolution of Scientific management: Principles and functions of scientific management, Levels and skills of management.

Organizational structure: Authority, responsibility and span of control -system concept of management - Line and staff, project and matrix organization.

Formation of companies: Proprietary Partnership and joint stock companies – private limited, public limited companies, cooperative organizations and Government organizations.

Module – II

Selection of site- factors to be considered – Economic vs. social significance of location.

Plant layout- different types- process, product, fixed position and group technology layout. Personnel management - objectives and function-recruitment, selection, orientation and training of workers Industrial safety and health - Labour welfare –Industrial psychology.

Module – III

Sales management: Objectives and function - Marketing: Concepts, Market segmentation-marketing mix-product life cycle. Forecasting of demand – different - methods (simple problems).

Decision making-Types of decisions-The decision making process - decision tree - linear programming and its application in management, transportation and assignment problems.

Module – IV

Game theory and its applications - Queuing theory: Single server models- network theory – CPM – crashing of networks, PERT – probability of completion.-Simulation modeling (Basic concepts only), Advantages and disadvantages of simulation.

References:

1. Chabra T. N., *Principles & Practice of Management*, Dhanpat Rai Pub.
2. Mahajan M*., Industrial Engineering & Production Management*, Dhanpat Rai Pub.
3. Barry Render and, Ralph M Stir Jr., *Quantitative Analysis for Management*, Prentice Hall India, New Delhi.
4. Hillier and Lieberman, *Fundamentals of Operations Research*, Kluwer Academic Pub.
5. Basu C. R., *Business Organization & Management*, Tata McGraw Hill.
6. Tripathi and Reddy, *Principles of Management*, Tata McGraw Hill.
7. Fraidoon Mazda, *Engineering Management*, Pearson Edn. Asia.
8. Bernaud W. Taylor III, *Introduction to Management Science*, Pearson Edn, Asia.
9. Koontz and Weihrich, *Essentials of Management*, Tata McGraw Hill.
10. Meenakshi Gupta, *Principles of Management,* PHI Learning, New Delhi.
11. Telsang M., Industrial Engineering and Production Management, Dhanapat Rai Pub.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course the students will be able to have an understanding of various tools and techniques for the efficient and effective use of resources in an organization and application of these techniques for better management of the organization.

13.702 MECHATRONICS (MPSU)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the features of various sensors used in CNC machines and robots.*
- *To study the fabrication and functioning of MEMS pressure and inertial sensors.*
- *To develop hydraulic/pneumatic circuit and PLC program for simple applications.*

Module – I

Introduction to Mechatronics: Structure of Mechatronics system. Sensors - Characteristics - Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental and absolute, gray coded encoder. Resolvers and synchros. Piezoelectric sensors. Acoustic Emission sensors. Principle and types of vibration sensors.

Module – II

Actuators: Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, process control valves. Rotary actuators. Development of simple hydraulic and pneumatic circuits using standard Symbols.

Micro Electro Mechanical Systems (MEMS): Fabrication: Deposition, Lithography, Micromachining methods for MEMS, Deep Reactive Ion Etching (DRIE) and LIGA processes. Principle, fabrication and working of MEMS based pressure sensor, accelerometer and gyroscope.

Module – III

Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines - Mechatronics elements - Machine structure: guide ways, drives. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws, pre-loading methods. Re-circulating roller screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools. Programmable Logic Controllers (PLC) –Basic structure, input/ output processing. Programming: Timers, Internal Relays, Counters and Shift registers. Development of simple ladder programs for specific purposes.

System modeling - Mathematical models and basic building blocks of general mechanical, electrical, fluid and thermal systems.

Module – IV

Mechatronics in Robotics-Electrical drives: DC, AC, brushless, servo and stepper motors. Harmonic drive. Force and tactile sensors. Range finders: ultrasonic and light based range

finders. Robotic vision system - Image acquisition: Vidicon, charge coupled device (CCD) and charge injection device (CID) cameras. Image processing techniques: histogram processing: sliding, stretching, equalization and thresholding.

Case studies of Mechatronics systems: Automatic camera, bar code reader, pick and place robot, automatic car park barrier system, automobile engine management system.

References

1. Bolton W., *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, Person Education Limited, New Delhi, 2007
2. HMT, *Mechatronics*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. Ramachandran K. P., G. K. Vijayaraghavan, M. S. Balasundaram, *Mechatronics: Integrated Mechanical Electronic Systems*, Wiley India Pvt. Ltd., New Delhi, 2008.
4. David G. Aldatore, Michael B. Histand, *Introduction to Mechatronics and Measurement Systems*, McGraw-Hill Inc., USA, 2003.
5. Vijay K. Varadan, K. J. Vinoy, S. Gopalakrishnan, *Smart Material Systems and MEMS: Design and Development Methodologies*, John Wiley & Sons Ltd., England, 2006.
6. Saeed B. Niku, *Introduction to Robotics: Analysis, Systems*, Applications, Person Education, Inc., New Delhi, 2006.
7. Gordon M. Mair, *Industrial Robotics*, Prentice Hall International, UK, 1998.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able:

- *To discuss mechanical systems used in mechatronics*
- *To integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.*

13.703 AUTOMOTIVE AIR CONDITIONING SYSTEMS (U)

Teaching Scheme: 4(L) - 0(T) - 0(P) **Credits**: 4

Course Objectives:

To know about the construction and working of components related to Automotive Air-conditioning and refrigeration.

Module – I

Air conditioning Fundamentals: Definition of Air Conditioning, Psychrometry and air composition Adiabatic saturation and Thermodynamic wet bulb temperature Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports. Thermostatic expansion value - Expansion value calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator.

Module – II

Air Conditioner - Heating System: Automotive heaters - Manually controlled air conditioner - Heater system - Ford automatically controlled air conditioner and heater systems - Automatic temperature control - Air conditioning protection – Engine protection.

Module – III

Refrigerant: Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures.

Module – IV

Air Routing & Temperature Control: Objectives - Evaporator care air flow through the Dash recirculating unit - Automatic temperature control – Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems.

Air Conditioning Service: Air conditioner maintenance and service - Servicing heater system Removing and replacing components. Trouble shooting of air controlling system – Compressor service.

References:

1. William H Crouse and Donald L Anglin, *Automotive Air conditioning*, McGraw-Hill Inc., 1990.
2. Mitchell information Services, Inc, *Mitchell Automatic Heating and Air Conditioning Systems*, Prentice Hall Ind., 1989.
3. Paul Weiser, *Automotive Air Conditioning*, Reston Publishing Co Inc., 1990.

4. MacDonald K. L., *Automotive Air Conditioning*, Theodore Audel Series, 1978.
5. Leslie. F. Gamines and Boyce L. Dwiggins, *Automotive Air Conditioning.*
6. Damkundwar, *Refrigeration and Air Conditioning.*
7. Arora C. P., *Refrigeration and Air Conditioning.*

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

At the end of the course students will be familiar about the working principle and various components related to Air-conditioning and Refrigeration.

13.704 ENGINE AND DRIVE LINE DESIGN (U)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To know about the fundamentals about the design of automotive engine and drive line components.*
- *To get the idea about the application of the design concept in automotive industries.*

Module – I

Design of IC engine components: Design of cylinder, piston, connecting rod, Crank shaft, design of fly wheel- turning moment diagram, functions of flywheel, fluctuations of energy and speed in flywheel, size of the flywheel.

Module – II

Bearings: Types of lubrication, Classification of bearings, Journal bearings, Mechanisms of film lubrication, Theories of Lubrication, viscosity, bearing modulus, coefficient of friction, Petroff's equation and bearing characteristic number, minimum oil film thickness, heat dissipation of bearings, bearing materials, selection of bearing, bearing design

Rolling contact bearings:- ball and roller bearings, types, mechanics of rolling friction, bearing life, static and dynamic load rating, equivalent bearing load, Design of ball and roller bearings, selection of bearing.

Module – III

Clutches & brakes: Design of single plate, multi plate, centrifugal and cone clutches, design factors for brakes, Design of internal expanding shoe brakes, Design of disc brakes, heat rejected during braking, torque transmitted by leading and trailing shoes during braking, braking force, weight shifted during braking, Problems.

Axle & Steering systems: Design of front and rear axles - live and dead axles, Condition for true rolling, turning circle radius of wheels, angle of inside lock and outside lock - problems.

Module – IV

Design of gears: Classification of Gears, Nomenclature, Lewis equation and Lewis form factor, working stresses in gear teeth, dynamic load on gear teeth, wear load, Design of spur gear, helical gear, bevel gear and worm gear, AGMA standards. Analysis of forces on spur, helical, bevel and worm gears

Design of Gear box: Structure and ray diagram (up to 6 speeds), design of gear box.

Design Data Hand books:

1. PSG Tech., *Machine Design Data Handbook*.
2. Mahadevan, *Design Data Book*, CBS Pub.

References:

1. Spotts M. F., Design of Machine Elements, Prentice Hall of India.
2. Shigley J. E., *Machine Design,* McGraw Hill Book Co.
3. Giri N.K., *Automobile Mechanics*, Khanna Publishers, New Delhi.
4. Heldt P. M., *Torque Converters*, Chillon Book Co., 1952.
5. Heldt P. M., Automotive Chassis, Chillon Book Co., 1952.
6. Sadhu Singh, *Machine Design*, Khanna Publishers.
7. Sharma S. C. and D. K. Aggarwal, *Machine Design*, S.K. Kataria and Sons.
8. Rajendra Karwa, *A Text Book of Machine Design*, Laxmi Publications.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved charts and tables are permitted in the examination hall.*

Course Outcome:

At the end of the course students will be familiar about the design of Automotive Engine and Drive Line Components. Students will be familiar about the application of the concept in projects and automotive industry.

13.705 MODERN AUTOMOTIVE TECHNOLOGY (U)

Teaching Scheme: 4(L) - 0(T) - 0(P) **Credits:** 4

Course Objectives:

To know the recent developments in Automotive Technology and Trends. Familiar with various developments and components with latest technologies used in Automobile Industry.

Module – I

Electric and Hybrid Vehicle technology: Introduction, LEV, TLEV, ULV & ZEV, Basic components of Electric vehicles, Batteries suitable for electric vehicles, motor and controllers, constructional features,

Basic factors to be considered for converting automobiles to electric vehicle, electric hybrid vehicle, types - series and parallel hybrid, layouts, comparison, Power systems and control systems, Different modes of operation for best usage. Regenerative braking.

Module – II

Recent Trends in Automotive Power Plants: Stratified charged / lean burn engines – Hydrogen Engines- Electric propulsion with cables – Magnetic track vehicles.

Vehicle Operation and Control: Computer Control for pollution and noise control and for fuel economy-Transducers and operation of the vehicle like optimum speed and direction.

Module – III

Fuel Cells and Alternative energy systems: Introduction to fuel cells, Operational fuel cell voltages, Proton Exchange membrane fuel cells, Alkaline Electrolyte fuel cells, Medium and high temperature fuel cells, fuel and fuel chose, fuel processing, fuel cell stacks, Delivering fuel cell power, Integrated Air supply and humidification concepts for fuel cell systems, A comparison of High pressure and low pressure operation PEM Fuel cell systems, Fuel cell Auxiliary systems,

Modern Developments in Automobiles: Air compression systems, Air powered vehicles, Vehicle Automated Tracks: Preparation and maintenance of proper road network-National highway network with automated roads and vehicles-Satellite control of vehicle operation for safe and fast travel.

Module – IV

Modem electronic and micro control systems in automobiles: Electronically controlled concealed headlight systems, LED and Audible warning systems Electro chromic mirrors, automatic review mirrors, OBD II, Day time running lamps (DRL), Head up display, Travel information systems, On board navigation system, Electronic climate control, Electronic

cruise control, Antilock braking system, Electronically controlled sunroof, Anti-theft systems, Automatic door locks (ADL), engine management system, Electronic transmission control, chassis control system, Integrated system.

References:

1. Bob Brant, *Build Your Own Electric Vehicle.*
2. SAE, Electric and Hybrid Electric Vehicles and Fuel Cell Technology, SAE.
3. Andrew Dicks and James Laminine, *Fuel Cell Systems Explained*, SAE.
4. SAE, Fuel cells and alternative fuels / Energy systems
5. SAE, *Fuel Cell Power for Transportation*, 2001.
6. Rickard Stobart, *Fuel Cell Technology for Vehicles,* SAE.
7. Barry Hollembeak, *Automotive Electricity*, *Electronics and Computer Controls*, Delmer Publishers.
8. Tom Denton, *Automotive Electronics*, SAE
9. Beranek. L. L., *Noise Reduction*, McGraw-Hill Book Co., Inc, New York, 1993.
10. Bosch Hand Book, 3rd Edition, SAE, 1993.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of approved data book is permitted in the examination hall.*

Course Outcome:

At the end of the course students will be familiar about latest developments in Automobile Industry and familiar with the construction and working of various latest components used in new generation vehicles.

13.706.1 PLANT ENGINEERING & MAINTENANCE (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge in plant engineering and maintenance.*
- *To become familiar with maintenance management.*
- *To study the different maintenance management schemes.*

Module – I

Wear –fundamentals and analysis – Classification – Theories of wear – Wear –fundamentals Analytical treatment of wear - Effect of moisture , gas and liquids on wear –Effect of temperature – Fatigue. Wear prevention methods. Lubricants – Solid , fluid and semi fluid – Synthetic – General properties and applications – Tests and classifications – Additives-Testing of lubricants selection of lubricants-lubricating mechanisms.

Module – II

Reliability – Analysis and Concepts – Chance failure and wear out failure –Application of stochastic model for reliability studies – Reliability of series , parallel and stand –by systems – Estimation of parameters for failure distributions – Maintainability -availability.

Module – III

Replacement – Analysis of different models - Causes of deterioration and obsolescence – Sudden and gradual obsolescence. Deterioration – MAPI method –simple problems .Maintenance – types (corrective, scheduled, preventive, predictive and proactive maintenance). – Deterioration and failure analysis – planning ,scheduling and controlling of maintenance work – organisation for maintenance.

Module – IV

Safety engineering, accident prevention programme, safety design concepts, fire protection-industrial noise-Legislations on safety in industry. Recent Developments in maintenance methods – RCM - CBM –DMS – TPM etc.

References

1. Miller and Blood, *Modern Maintenance Management*, D B Tarapur.
2. *Plant Engineer's Hand Book*, McGraw Hill.
3. Maynard H.B, *Industrial Engineering Hand book*, McGraw-Hill, 2001
4. Irason W. G., *Reliability Hand Book*, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able:

- *To discuss wear and theories of failure.*
- *To suggest maintenance schemes.*
- *To discuss safety issues and related rules.*

13.706.2 FRACTURE MECHANICS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get knowledge in fracture phenomena in metals and non-metals.*
- *To become familiar with testing methods.*

Module – I

Introduction: Significance of fracture mechanics - Griffith energy balance approach -Irwin's modification to the Griffith theory - stress intensity approach - crack tip plasticity - fracture toughness - sub critical crack growth - influence of material behaviour - modes I, II & III - mixed mode problems Linear elastic fracture mechanics (LEFM): Elastic stress field approach - mode I elastic stress field equations - expressions for stresses and strains in the crack tip region - finite specimen width - superposition of stress intensity factors (SIF) – SIF solutions for well known problems such as centre cracked plate, single edge notched plate, and embedded elliptical cracks.

Module – II

Crack tip plasticity: Irwin plastic zone size - Dugdale approach - shape of plastic zone - state of stress in the crack tip region - influence of stress state on fracture behaviour Energy balance approach: Griffith energy balance approach - relations for practical use - determination of SIF from compliance - slow stable crack growth and R-curve concept - description of crack resistance LEFM testing: Plane strain and plane stress fracture toughness testing - determination of R-curves - effects of yield strength and specimen thickness on fracture toughness - practical use of fracture toughness and R-curve data.

Module – III

Elastic plastic fracture mechanics (EPFM): Development of EPFM - J-integral – crack opening displacement (COD) approach - COD design curve - relation between J and COD - tearing modulus concept - standard JIc test and COD test Fatigue crack growth**:** Description of fatigue crack growth using stress intensity factor - effects of stress ratio and crack tip plasticity - crack closure - prediction of fatigue crack growth under constant amplitude and variable amplitude loading - fatigue crack growth from notches - the short crack problem.

Module – IV

Sustained load fracture: Time-to-failure (TTF) tests - crack growth rate testing - experimental problems - method of predicting failure of a structural component - practical significance of

sustained load fracture testing Practical problems: Through cracks emanating from holes - corner cracks at holes - cracks approaching holes - fracture toughness of weldments - service failure analysis - applications in pressure vessels - pipelines and stiffened sheet structures.

References

1. Ewalds H. L. and R. J. H. Wanhill, *Fracture Mechanics*, Edward Arnold Edition.
2. Broek D., *Elementary Engineering Fracture Mechanics*, Sijthoff & Noordhoff Int. Pub.
3. Kare Hellan, *Introduction to Fracture Mechanics*, McGraw Hill Book Company.
4. Prashant Kumar, *Elements of Fracture Mechanics*, Wheeler Publishing.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To predict material failure for any combination of applied stresses.*
- *To estimate failure conditions of a structure.*
- *To predict the likelihood of failure of a structure containing a defect.*

13.706.3 ENTREPRENEURSHIP DEVELOPMENT (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain knowledge entrepreneurship process.*
- *To become familiar industrial policies.*
- *To know process strategies for starting a venture.*

Module – I

Entrepreneurial perspectives - understanding of entrepreneurship process - entrepreneurial decision process - entrepreneurship and economic development - characteristics of entrepreneur - entrepreneurial competencies- managerial functions for enterprise.

Module – II

Process of business opportunity identification and evaluation - industrial policy - environment - market survey and market assessment - project report preparation - study of feasibility and viability of a project - assessment of risk in the industry.

Module – III

Process and strategies for starting a venture - stages of small business growth, Entrepreneurship in international environment - achievement motivation – time management - creativity and innovation structure of the enterprise - planning, implementation and growth.

Module – IV

Technology acquisition for small units - formalities to be completed for setting up a small scale unit - forms of organizations for small scale units – financing of project and working capital - venture capital and other equity assistance available - break even analysis and economic ratios technology transfer and business incubation.

References

1. Harold Koontz and Heinz Weihrich, *Essentials of Management*, McGraw Hill
2. Hirich R. D. and M. P. Peters Irwin, Entrepreneurship, McGraw Hill
3. Rao T. V., M. V. Deshpande, Prayag Metha and M. S. Nadakarni, *Developing Entrepreneurship- A Hand Book*, Learning Systems.
4. Donald Kurado and Richard M. Hodgelts, *Entrepreneurship A Contemporary Approach*, The Dryden Press.
5. Patel V. G., *Seven Business Crisis*, Tata McGraw Hill.

6. Timmons J.A., *New Venture Creation-Entrepreneurship for 21st Century*, McGraw Hill.
7. Patel J. B. and S. S. Noid, *A Manual on Business Opportunity Identification, Selections*, EDII.
8. Pandey G. W., *A Complete Guide to Successful Entrepreneurship*, Vikas Publishing.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss the strategies for starting an a venture.*
- *To discuss industrial policies.*

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13.706.4 FINITE ELEMENT METHODS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To understand the fundamental concepts of the theory of the finite element method.*
- *To solve simple structural and heat transfer problems using finite element methods.*

Module – I

Introduction, historical background, applications, advantages, finite element softwares. Theory of elasticity - stress and equilibrium, stress-strain relationship, strain-displacement relationship, plane stress, plane strain and axi-symmetric approximation. Temperature effects. Potential energy and equilibrium, Principle of minimum potential energy. Discrete and Continuous systems, Rayleigh-Ritz method, Galerkin method. Solution of Algebraic equations, Banded and skyline solutions. Global, Local and Natural coordinates in 1, 2 and 3 dimensions - Area coordinates.

Module – II

Numerical Integration using Gauss quadrature. Finite element modeling - types of elements, Discretization, Mesh generation and numbering. Shape functions - types and properties. Iso parametric formulation. Largrangean and Serendipity elements. One dimensional elasticity problems - discretisation of domain into elements - generalised coordinates approach - derivation of elements equations - assembly of element equations - transformation matrices - global equations, load vector.

Module – III

Properties of stiffness matrices, imposition of Boundary conditions - penalty and elimination approach, multi-point constraints. Finite element formulation of plane trusses, beams and beams on elastic supports. Finite element formulation of 2D problems using constant strain triangle element and isoparametric quadrilateral element. Axi-symmetric solids subjected to axi-symmetric loading.

Module – IV

Features of 3D problems in stress analysis. Scalar field problems - one dimensional heat conduction through composite walls and fins, potential flow. Dynamic problems- Hamilton's principle, Mass matrices, lumped and consistent formulations.

References

1. Tirupathy. R. Chandrapatla and Ashok D. Belagundu, *Introduction to Finite Elements in Engineering*, Pearson.

2. Krishnamoorthy C. S., *Finite Element Analysis: Theory and Programming*, Tata McGraw Hill.
3. Reddy J. N., *Introduction to the Finite Element Method*, McGraw Hill.
4. Zienkieviz O. C and R.L.Taylor, *Finite Element Methods*, Butterworth Heinemann.
5. Cook R. D., *Concepts and Applications of Finite Element Analysis*, Wiley.
6. Rao S. S., *The Finite Element Method in Engineering*, Butterworth Heinemann.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To identify mathematical models for solution of common engineering problems.*
- *To formulate simple problems into finite elements.*
- *To solve simple structural and heat transfer problems using finite element method.*

13.706.5 METAL FORMING (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To gain deeper knowledge on metal forming under different conditions and in various processes.*
- *To do analyses of rolling and forging processes.*

Module – I

Basic laws and theories of plasticity - stress space - yield criterion of metals -Von-Mises yield criterion - Tresca criterion - representation of the criteria in stress space - yield surface - subsequent yield surfaces – experimental investigations of the yield criteria - basic considerations of plasticity theory - simple models of material behaviour - Levy-Mises stress strain relations - Prandtl-Reuss stress strain relations - experimental verification.

Module – II

Plastic potential theory - plastic work - maximum work hypothesis – stability postulates - isotropic and kinematic hardening - plastic flow - temperature and strain rate effects in plastic flow Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing.

Module – III

Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain. Classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane stain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming.

Module – IV

Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkeys theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications.

References

1. Oscar Hoffman and George Sachs, *Introduction to Theory of Plasticity for Engineers*, McGraw Hill.

2. Dieter G. E., *Mechanical Metallurgy*, McGraw Hill.
3. Johnson W. and Mellor P.B., Plasticity for Mechanical Engineers, D Van Nostrand Co. Ltd.
4. Chen W.F. & Han D.J., Plasticity for Structural Engineers, Springer Verlag.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To identify suitable process for a particular application.*
- *To discuss various processes such as rolling, forging etc. and also the theories*

13.706.6 NON-CONVENTIONAL MACHINING TECHNIQUES (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objective of this course is to introduce the various non traditional machining techniques.

Module – I

The need of the process classification - Energies employed in the processes- EDM, EC, USM, LBM, PAM, AJM, WJM etc. Electrical Discharge Machining Process, operating principles-Breakdown mechanism-Dielectric fluid-Electrode material-Tool wear – Power generator circuits- Process parameters - Metal removal rate - wire out EDM – Recent Developments in EDM. Applications.

Module – II

Electro Chemical Machining Process-principles-Equipment-Analysis of metal removal-tool material-Insulation-Process parameters-ECH,ECG etc. Applications Electron Beam Machining Process, Principle-gun construction - Types of gun - Vacuum and non-vacuum technique Applications Laser Beam Machining Process, principles, pumping processes, emission types-beam control. Applications.

Module – III

Ultrasonic Machining Process-working principles-types of transducers concentrators- nodal point clamping-feed mechanism-metal removal rate- Process parameters. Applications.

Module – IV

Abrasive Jet Machining Processes-Principle-Equipment-Metal removal rate process parameters. Applications.

Water Jet Machining Process- Introduction WJM Machine, Process Characteristics Process Performance, Applications.

References

1. Mishra P. K., *Non Conventional Machining*, The Institution of Engineers (India) Text Books: Series, 1997.
2. Sharma P. C., *A Text Books of Production Engineering*, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To identify suitable process for a particular application.*
- *To discuss the various non traditional machining techniques.*

13.706.7 EXPERIMENTAL METHODS IN ENGINEERING (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objective of this course is to introduce the various measuring instruments.

Module – I

Pressure measurement devices – U tube manometer – Well type manometer– Different types of manometers. Elastic pressure transducers – Bourdon tubes – Diaphragms – Bellows. Capacitance pressure gauge. Diaphragm type strain gauge pressure pickup. LVDT diaphragm differential pressure gauge. High-pressure measurement – very high-pressure transducer. Low-pressure measurement – Mc Leod-gauge pirani thermal conductivity gauge – Knudsen gauge – lonization gauge. Dead weight tester for static calibration of pressure gauges. Methods for flow measurement – Positive displacement methods – rotary vane flow meter – Lobed impeller flow meter. Flow obstruction methods – Venturi – flow nozzle – orifice. Practical considerations for obstruction flow meters. Recommended proportions for venturi tubes, flow nozzles and orifices. Flow measurement by drag effects – rotameter – turbine meter – vortex shedding flow meter. Hot wire and hot film anemometers. Thermal mass flow meter. Magnetic flow meter.

Module – II

Pressure probes – pitot tube – pitot static tube – Kiel probe. Yaw angle – yaw angle characteristics of various static pressure probes. Fluid factors, application factors and installation

factors of different types of flow meters. Temperature measurement by mechanical effects – mercury in glass thermometer – bimetallic strip type – fluid expansion thermometers. Temperature measurement by electrical effects – electrical resistance thermometer. Methods of correction for lead resistance – Siemens three lead arrangement – callender four lead arrangement and floating-potential arrangement. Thermostats. Temperature measurement due to thermo-electric effects – thermocouples – different types and its range – law of temperature –emf vs temp relationships for different thermocouples – sensitivity of thermocouples – thermopile and its practical application – installation of thermocouple on a metal plate – Thin foil thermocouples for rapid transient response. Temperature measurement by radiation – optical pyrometer.

Module – III

Thermal conductivity measurement – guarded hot plate apparatus –measurement of thermal conductivity of metals. Thermal conductivity of liquids and gases – guarded hot plate apparatus – concentric cylinder method – apparatus for determination of thermal

conductivity of gases at high temperatures. Measurement of viscosity – rotating concentric cylinder apparatus – Saybolt viscometer. Gas diffusion – measurement of diffusion coefficients in gases. Convection heat transfer measurements – forced convection heat transfer coefficients in smooth tubes. Humidity

measurements. Heat flux meters. Elastic elements for force measurements – simple cantilever and thin ring elastic elements – Proving ring. Torque measurements – hollow cylinder for torque measurement – Prony brake – hydraulic dynamometer – Cradled dynamometer.

Module – IV

Strain measurements – electrical resistance strain gauges-different types – characteristics of strain gauge materials. Temperatures compensation for electrical resistance strain gauges strain gauge rosettes –bonded and unbounded resistance strain gauges. Cantilever beam used as a frequency measurement device. Principles of seismic instrument – practical considerations for seismic instruments –electrical resistance strain gauge seismic instrument – piezoelectric transducer type seismic instrument. Sound measurements – microphones – characteristics of microphones. Psychoacoustics factors – sound level meter– acoustic properties of materials – sound absorption coefficient – noise reduction coefficient. Air pollution measurement – units for pollution measurement – air pollution standards – Air sampling train.

References

1. Holman J.P., *Experimental Methods for Engineers*, McGraw-Hill.
2. Ernest O. Doebelin, *Measurement System – Application and Design*, McGraw-Hill.
3. Donald P. Eckman, *Industrial Instrumentation*, John Wiley.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To identify the suitable instrument for measuring transport parameters*
- *To detect suitable range of pressure gauge and compute*
- *To distinguish different flow visualization methods and temperature measurements.*
- *To determine thermal conductivity in solids, liquids and gases and radiation measurements.*

13.706.8 MECHANICAL VIBRATION & NOISE CONTROL (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To apply the laws of motion to oscillating systems*
- *To examine the effects of energy-removal mechanisms; i.e. damping.*
- *To introduce modes of vibration in terms of system physical parameters.*
- *To introduce types of noise and noise control.*

Module – I

Introduction – Harmonic motion – Beat frequency – Equations of motion –Concepts of forces and equilibrium – Systems with one degree of freedom –Free and forced vibrations with undamped and damped systems (Review) Two degrees of freedom systems : Equations of motions for free and forced vibration without and with damping – Use of influence coefficients – The work and energy approach – Solutions to free , forced and damped vibrations and torsional systems – Dynamic absorbers periodic and Non periodic.

Module – II

Vibration – Fourier series representation – Unit impulse step , ramp and arbitrary excitation – Response spectrum – Analog computer set up for solving vibration problems -,Vibration measuring instruments . Solutions to Differential Equations, Laplace Transforms. Jump phenomenon – Effect of damping – Self excited Oscillations.

Module – III

Introduction to sound and vibratic wave motion – One dimensional plane waves – Characteristics impedance – Decibel seats power, density and intensity – Sound transmission through one and two intervening media. Measurement of Sound – Loud speakers and microphones – Their characteristics, Band pass filters, graphic level recorder, Narrow Band Analysers - Measurement in reverberation and Vachaic chamber –Hearing mechanism of hearing and perception of sound (Description only).

Module – IV

Types of noise : Criteria for evaluation of noise problems – Threshold of hearing – Hearing loss with age – Equal loudness contours loudness and loudness level – Perceived noise level – N.C. curves – Noise and Number index – Noise pollution level – Noise induced hearing loss – Damage risk criteria – Criteria for noise and vibration in community buildings – General principles of noise control – Use of enclosures – Wrappings – Porous materials – Design of

Auditorium – Acoustical requirements – Elimination of room acoustical defects – Articulation index – Sound reinforce systems – Design of time delays (Brief description only).

References

1. Anderson Roger A., *Fundamentals of Vibration*, Macmillan.
2. Thomsom W. T., *Theory of Vibrations*, Tata McGraw Hill.
3. Timoshenko, *Vibration problem in Engineering*, John Wiley & Sons.
4. Francis S. Tse, Ivan E. Morse and R.T. Hinkle, *Mechanical Vibrations*, Allyn and Bacon.
5. Kinslor and Frey, *Fundamentals of Acoustics*, J. Wiley & Sons.
6. Beronek .L. L., *Noise and vibration Control*, McGraw Hill.
7. Doello and Deslie L, *Environmental Acoustics*, McGraw Hill.
8. Harris C*., Hand Book on Noise control*, McGraw-Hill.
9. *Hand Book of Noise Measurement* – General Radio Company .U.S.A.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To appreciate the need and importance of vibration analyses in mechanical systems.*
- *To analyze the mathematical model of vibratory systems.*
- *To discuss source of noise and types of noise.*

13.706.9 FAILURE ANALYSIS (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To get knowledge in failure investigation and analysis.*
- *To introduce experimental stress analysis.*
- *To get knowledge in fracture mechanics.*

Module – I

Introduction: Objectives of failure investigation, Collection of background data service history, photographic records, Selection of samples for various conditions, Preliminary examination of the failed part – visual inspection and non destructive techniques for failure investigation- Magnetic particle inspection, Liquid penetrant inspection, Eddy current inspection, ultrasonic inspection, radiography, acoustic emission inspection.

Module – II

Experimental stress Analysis Mechanical testing, limitations of tensile testing, Selection preservation and cleaning of fracture surfaces- cleaning, sectioning, opening secondary cracks Macroscopic examination of fracture surfaces, Microscopic examination of fracture surfaces – optical microscopy, scanning electron microscopy, transmission electron microscopy, Selection and preparation of metallographic sections, Examination and analysis of metallographic sections.

Module – III

Determination of fracture type- Failure mechanisms and Fractography of ductile fracture, brittle fracture, transgranular brittle fracture, Intergranular brittle fracture Fatigue fracture- Mechanisms and general features of fatigue fracture Stress corrosion cracking, Liquid metal embrittlement, Hydrogen embrittlement, Creep and stress rupture failures, ductile to brittle fracture transition Chemical analysis- Analysis of bulk materials, analysis of surfaces and deposits, spot tests.

Module – IV

Applications of fracture mechanics: Fracture mechanics concepts- Linear elastic fracture mechanics, Elastic-Plastic fracture mechanics (basic concepts), plane stress and plane strain, Fatigue crack growth rate their use in failure analysis, fracture toughness testing- Plane strain fracture toughness test, COD test, Simulated service testing, Analyzing the evidences

formulating conclusions and report writing, Case studies of failures: failures of shafts, failures of heat exchangers.

References

1. *ASM Handbook Volume 11: Failure analysis and Prevention.*
2. Prashant Kumar, *Fracture Mechanics*, Wheeler Publishing.
3. Dieter, *Mechanical Metallurgy*, McGraw Hill.
4. Goodhew P. J., J. Humphreys and R. Beanland, *Electron microscopy and analysis*, Taylor and Francis, 2001.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of this course the students will be able:

- *To investigate failure using various techniques.*
- *To discuss the various tools/equipment used for investigations of failure.*
- *To discuss the various types of fracture and also application of fracture mechanics.*

13.706.10 INDUSTRIAL AUTOMATION (MPU) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To introduce the automation and types of automation*
- *To gain knowledge in pneumatics*
- *To introduce robotics and automatic assembly process.*

Module – I

Introduction: Basic concept of Automation, Types of Automation, Feasibility etc. Industrial Hydraulics: Introduction, basic concepts, Hydraulic fluids, Classification and properties of hydraulic fluids, Contaminates in hydraulic system, control and cleanliness standards, Fluid power generators, i.e. Gear, Vane, Piston pumps, linear and Rotary Actuators, Direction Control Valves, types, actuation methods, pressure control valves; pressure reducing valves, pressure relief valve, Unloading valve, Sequence valve, Counterbalance valve, Flow control valves simple and pressure compensated type.

Module – II

Pneumatics: Introduction, Basic components, Source, storage and distribution, treatment of compressed air, linear and Rotary actuators, Direction control valves – types, actuation methods, pressure control valves, logic devices – twin pressure valve, shutter valve, time delay valve, Pneumatic circuit design and analysis, conventional as well as computer aided design.

Module – III

Robotics: Basic concepts, classification based on Geometry, programming, drives, work volume of robots world and joint coordinates various joints, DOF, end effectors – Types and uses, Sensors in Robots, programming – Teach pendant and Computer programming, Introduction to forward and inverse kinematics, Applications of Robots.

Module – IV

Automatic Assembly System: Development of Automatic Assembly process, Transfer devices – continuous, Intermittent, synchronous and asynchronous, Vibratory feeders – Mechanics, effect of frequency, acceleration, track angle, friction, load sensitivity, orientation of parts – active and passive devices, Mechanical feeders – computation and operational details, feed

tracks, Escapement devices. Product design for high-speed automatic assembly examples of design modifications.

References

1. Anthony Esposito, *Fluid Power with Application*, 5/e, Pearson Education, 2003.
2. Majumdar S. R., *Oil Hydraulic System*, Tata McGraw Hill, 2001.
3. Bolton W, Mechatronics, 2nd Edition, Pearson Education, New Delhi, 1999.
4. Necsulelscu Dan, *Mechatronics*, Pearson Education, New Delhi, 2002.
5. Geoffrey Boothroyd, *Assembly Automation and Product Design*, Marcel Dekker Inc, 1991.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be able

- *To discuss automation and various components used*
- *To discuss robotics and applications of robots*
- *To implement automatic assembly system.*

13.706.11 VEHICLE PERFORMANCE AND TESTING (U) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

To know about various performance parameters and testing equipments used in Automotive Industry.

Module – I

Laboratory testing: Basic engine parameters, Measurement of BHP, IHP, Engine testing on dynamometers, different types of dynamometers- hydraulic, eddy current etc, engine analyzers- for petrol and diesel engines, FIP calibrating and testing, exhaust gas analyzers - various types- Orsat apparatus, infrared gas analyzers, smoke meter.

Vehicle testing on chassis dynamometers: two wheel & four wheel dynamometers, vehicle testing lanes - side slip testers, wheel alignment testing, wheel balancing, brake testers, head light alignment testing.

Module – II

Noise vibration and Harshness: Review of vibration fundamentals, vibration control, fundamentals of acoustics, human response to sound, automotive noise criteria, Standard noise measurement methods, Noise inside and outside the vehicle, sources of vehicle noise- intake and exhaust noise, combustion noise, mechanical noise, noise from auxiliaries, wind noises, transmission noises, brake squeal, structure noise, noise control methods.

Module – III

Vehicle performance: Methods for evaluating vehicle performance- energy consumption in conventional automobiles, performance, emission and fuel economy, Operation of full load and part conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, CAFÉ standards.

Module – IV

Road and track testing: Initial inspection, PDI, Initial free services, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks.

References

1. Giles J. G., *Vehicle Operation and Performance*, Wildlife Publications, London, 1969.
2. Crouse W. H. and L. Anglin, *Motor Vehicle Inspection*, McGraw Hill Book Co., 1978.

3. Giri N. K., Automotive Technology, Khanna Publishers, 2009.
4. SAE Transaction papers- 831814,820346,820367,820371 and 820375
5. Julian Happian and Smith, An Introduction to Vehicle Design, SAE, 2004.
6. *Advanced Automotive Technology – Visions of a Super Efficient Family Car*- Technical paper, - OTA-ETI-638, 1995.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course, students will be knowing about the various parameters related to vehicle performance and testing methods adopted in the Automotive Industry.

13.706.12 AUTOMOTIVE AERODYNAMICS (U) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

To know the importance and various factors related to Automotive Aerodynamics.

Module – I

Introduction scope - historical development trends - fundamental of fluid mechanics - flow phenomenon related to vehicles -external & internal flow problem - resistance to vehicle motion - performance - fuel consumption and performance - potential of vehicle aerodynamics.

Module – II

Aerodynamic drag of cars, cars as a bluff body - flow field around car - drag force - types of drag force - analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic development - low drag profiles.

Module – III

Shape optimization of cars front end modification - front and rear wind shield angle - boat tailing - hatch back, fast back and square back -dust flow patterns at the rear - effects of gap configuration - effect of fasteners.

Wind tunnels for automotive aerodynamic introduction - principle of wind tunnel technology - limitation of simulation - stress with scale models – full scale wind tunnels - measurement techniques - equipment and transducers - road testing methods – numerical.

Module – IV

Vehicle handling the origin of forces and moments on a vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments - characteristics of forces and moments - dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

References

1. Hucho W. H., *Aerodynamic of Road Vehicles*, Butterworths Co. Ltd., 1997.
2. Pope A., *Wind Tunnel Testing*, John Wiley & Sons, 2nd Edn, New York, 1974.
3. *Automotive Aerodynamic*: Update SP-706, SAE, 1987.
4. *Vehicle Aerodynamic*, SP-1145, SAE, 1996

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be familiarize with the Aerodynamics fundamentals and its implementation in Automobiles.

13.706.13 TRACTORS AND FARM EQUIPMENTS (U) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

The main objectives of this course are

- *To know the construction working of various types of tractors and the components.*
- *To know about the various implements used for the tractors.*

Module – I

General Description of Tractors: Classification of tractors - Components of tractor - Safety rules. Layout of wheeled tractor, hydraulic control system, power take off, tractor stability and ride characteristics.

Module – II

Layout of crawler tractors, crawler details, methods of selection of equipments, selection of machines, basic rules for matching machines, selection of equipments including the nature of operating selection based on the type of soil, selection based on haul distance, selection based on weather conditions.

Module – III

Power Plant in Tractors: Engine cycles – Operation of multicylinder engines - General engine design - Basic engine performance characteristics, Cylinder and pistons - Connecting rods and crankshafts - Engine balancing - Construction and operation of the valve mechanism - Valve mechanism components.

Cooling system - Classification - Liquid cooling system - Components, Lubricating system servicing and troubles - Air cleaner and turbo charger - Fuel tanks and filters - Fuel pumps.

Module – IV

Control System of Tractors: power transmission, steering system, brakes and braking system, wheels, rims and tyres and accessories of wheeled tractors, power transmission, steering clutch and braking system in crawler tractors.

Agricultural Implements: Working attachment of tractors - Farm equipment - Classification - Auxiliary equipment - Trailers and body tipping mechanism.

References

1. Rodichev and G. Rodicheva*, Tractor and Automobiles*, MIR Publishers, Moscow, 1987.
2. Kolchin A. and V. Demidov, *Design of Automotive Engines for Tractor*, MIR Publishers, Moscow, 1972.

3. Guruvech A. and B. Sorekin, *Tractors*, MIR Publishers Moscow, 1975.
4. Geleman and M. Maskovin, *Farm Tractors*, MIR. Publishers, Moscow, 1975.
5. Smith H. P. and L. H. Wilkes, *Farm Machinery and Equipment*, TATA McGraw Hill Publications, 1977

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

At the end of the course students will be familiarize with the Tractors and Farm Equipments construction and working.

13.707 VEHICLE RECONDITIONING AND TESTING LAB (U)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective:

To make the students aware about various reconditioning equipments and their use. To know about the testing equipments of Automobile. The students should know about total reconditioning procedure and the testing techniques for checking the performance of the engine.

List of Experiments:

Reconditioning work of the following engine components and accessories with the help of special tools and Machines

1. Cylinder reconditioning**:** Checking the cylinder bore, setting the tool, re-boring operation (Work with portable re-boring machine, bore dial gauge, venire caliper, etc)
2. Checking the exhaust of gasoline vehicle with infra red gas analyzer and timing the carburetor. (Work with Infrared Exhaust gas analyzer)
3. Checking the emission of diesel vehicle with smoke meter. (Work with Diesel smoke meter)
4. Wheel alignment: Checking the camber, caster, kingpin inclination, toe in & out with optical aligner or computerized wheel aligner. (Work with computerized wheel aligning machine)
5. Wheel balancing: Balancing of wheels by using computerized wheel balancing machine.
6. Vehicle testing - Performance Testing of vehicle with chassis dynamometers (2 / 4 wheelers)
7. Checking the engine with Scan tool and familiar with DTC.
8. Brake testers: Testing of brakes using brake testers
9. Testing of Shock Absorbers.
10. Head Light Aiming and Focusing with Head light aligners.
11. Testing auto electrical components:
    a) Battery testing - Specific gravity test, open volt test, HRD test.
    b) Testing generator and regulator - testing the generator for short circuit, open circuit, testing the regulator unit
    c) Testing and checking of spark plugs - Cleaning and testing the spark plug with spark plug cleaner & testing machine.
    d) Testing of ignition coil
    e) Checking of dwell angle and rpm.

Note: At least 8 Experiments to be completed from the above experiments

Internal Continuous Assessment *(Maximum Marks-50)*

20% - Test/s

60% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of exercises prescribed.

70% - Procedure, conducting experiment, results, tabulation and inference.

10% - Fair record

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course the students would know about the various reconditioning techniques and testing of automobiles.

13 .708 MECHATRONICS LAB (U)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

To make the students familiar with

- *Use of Lab view and its applications.*
- *Programming and interfacing of PLCs and Microcontrollers.*

List of Experiments:

1. Virtual instrumentation using Lab view
2. Programming and Interfacing with PLCs and Microcontrollers
3. Temperature, Flow, Liquid level, Pressure control
4. Motion Control Experiments using
   a). Stepper Motor
   b). Servo Trainer kit

Note: At least 8 Experiments to be completed from the above instruments

Internal Continuous Assessment *(Maximum Marks-50)*

20% - Test/s

60% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on the list of experiments prescribed.

70% - Procedure, conducting experiment, results, tabulation and inference.
10% - Fair record
20% - Viva voce
Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

At the end of the course the students would be familiar with the usage of Lab view, programming and interfacing of PLCs and Microcontrollers.

13 .709 PROJECT AND PROJECT SEMINAR (MNPSU)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To identify a problem for the final-year project, outline a solution, and prepare a preliminary design for the solution.*
- *To do a detailed study on the selected topic based on current journals or published papers and present seminars*
- *To improve the ability to perform as an individual as well as a team member in completing a project work.*
- *The seminar based on the project provides students adequate exposure to presentations to improve their communication skills.*

The student shall do a project (project phase 1) in the seventh semester, which shall be continued in the eight semester. He/she shall submit an interim report at the end of the seventh semester and the final project report shall be submitted at the end of the eighth semester. The student shall present two seminars in the seventh semester on the work carried out during project phase 1. The first seminar should highlight the definition of problem, novelty of the project, literature survey and work plan/ methodology. The second seminar should include preliminary results. The students may be assessed individually/ and in groups.

Internal Continuous Assessment *(Maximum Marks-100)*

40% - Assessment by the Guide

40% - Assessment by the Committee.

20% - Regularity in the class

Course Outcome:

At the end of the course, the students would have acquired the basic skills to for performing literature survey and paper presentation. This course shall provide students better communication skills and improve their leadership quality as well as the ability to work in groups, and thus aid them in building a successful career as an engineer.