

NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Third Year Engineering

(Automobile Engineering)

Faculty of Engineering and Technology



Teacher's and Examiners Manual

Semester V & VI

Automobile System (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit – I

1. Teacher should facilitate learning of

1.		No. of Lectures - 8 Marks : 16	Lectures required
	<u>Vehicle layouts and specification</u>		
	a	Vehicle specification, vehicle layouts, types of vehicles and their applications,	02
	b	Two and four wheelers, cars, Light commercial vehicles, Trucks, buses, earth moving machinery, highway vehicles, agricultural tractors,	02
	c	Construction of automobile and various systems of automobiles.	01
	<u>Chassis and frames</u>		
	d	Frame, sub frame, integral construction, frame alignment.	02
	e	Body bumpers, doors, hood, articulated vehicles, trailers and safety consideration.	01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-1 a, b, c, d, e.

Unit – II

2. Teacher should facilitate learning of

2.	Battery	No. of Lectures - 8 Marks : 16	Lectures required
	a	Introduction, Principles of battery operation, battery construction.	2
	b	Recharging of battery, Battery rating, battery capacity and battery efficiency.	2
	c	Checking specific gravity of battery, battery test.	2
	d	Battery charging, battery failure and battery troubles shooting.	2

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-2 a, b, c, d.

Unit – III

3. Teacher should facilitate learning of

3.	No. of Lectures – 8 Marks : 16	Lectures required
a	<u>Ignition systems</u> Conventional Ignition systems: Function, types of Ignition systems, components, Battery Ignition systems, Magneto Ignition systems, Testing of Ignition circuits, Ignition systems trouble shooting.	3
b	<u>Electronic Ignition systems</u> Introduction, principles of Electronic Ignition systems, pulse generator, distributor less ignition system.	2
c	<u>Starting systems:</u> Starting motors, starting devices, bendix drive, overrunning clutch drive, starting motor switch and control switch, starting system trouble shooting.	3

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-3 a, b, c.

Unit – IV

4. Teacher should facilitate learning of

4.	No. of Lectures - 8 Marks : 16	Lectures required
<u>Wheels, Tyres , and Tubes</u>		
a	Construction and types of wheels, wheel dimensions.	01
b	Types of tyres, tyre property , tyre material, consideration in trade design, wheels and tyre trouble shooting, retrading of tyres, Tubes, Natural rubbers and butyl flops.	02
c	Rims, types, and maintenance.	01
<u>Front axle and steering:</u>		
d	Introduction, front axle, factors of wheel alignment, steering geometry.	01
e	Steering mechanisms, cornering force, understeer and over steer, steering linkages, steering gears, steering ratio.	02
f	Special steering columns, power steering, advanced steering systems.	01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-4 a, b, c, d, e.

Unit – V

5. Teacher should facilitate learning of

5.	<u>Air conditioning systems</u>	No. of Lectures - 8 Marks : 16	Lectures required
	a	Definition of basic terms of psychometry such as DBT, WBT, RH, etc. Human comfort conditions.	2
	b	Temperature control system, Insulation methods in auto air conditioner, Study of typical auto air conditioner, location of window air conditioner.	3
	c	Study of typical air conditioner systems, various parts of systems, compressor performance and its effect on overall engine performance.	3

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-5 a, b, c.

References	
1	Dr. Kripal Singh, "Automobile Engineering" vol-I&II
2	R.B. Gupta, "Automobile Engineering" ;Satya prakashan, New Delhi
3	Newton, steed and Garret, "Motor vehicle", Butter worth, London
4	Narang G.B.S, "Automobile Engineering", Khanna publication, New Delhi
5	A.W. Judge, "Modern Transmission" Chapman and Hall std 1989
6	Nakara C.P., "Basic Automobile Engineering", Dhanpat Rai Publishing co.

Automobile Systems Lab

Teacher and Examiner should follow the following guidelines.

Teaching Scheme

	Hrs per week	No. of weeks	Total hour	Semester Credits
Lecture	02	14	28	01
Tutorial	--	--	--	--

Examination scheme:

End semester scheme (ESE)	25 marks
Internal continuous assessment (ICA)	25 marks

1. Teacher should facilitate any SIX of the following lab practice.

S.N.	Design of machine Element Lab	Lab Hours Required
1	To study different vehicle layouts & their comparison	02
2	To study various battery testing & battery charging methods.	02
3	To study battery ignition & magneto ignition system	02
4	To study Electronics ignition & distributor less ignition system	02
5	To study bendix drives and overrunning clutch type starting motors	02
6	To study of power steering mechanism	02
7	Trial on wheel alignment and wheel balancing machine	02
8	To study automobile air conditioning system	02

Guidelines for ICA:

ICA will based on Practical and Assignment submitted by student in form of journal.

Minimum three Assignments to be submitted based on theory syllabus.

References	
1	Dr. Kripal Singh, "Automobile Engineering" vol-I&II
2	R.B.Gupta, "Automobile Engineering" ;Satyaprakashan, New Delhi
3	Newton, steed and Garret, "Motor vehicle", Butter worth, London
4	Narang G.B.S, "Automobile Engineering", Khanna publication, New Delhi
5	A.W. Judge, "Modern Transmission" Chapmen and Hall std 1989
6	Nakara C.P., "Basic Automobile Engineering", Dhanpat Rai Publishing co.

Autotronics (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit – I

1. Teacher should facilitate learning of

1.	Autotronics and Sensors in Automobiles	No. of Lectures - 8 Marks : 16	Lectures required
a	Measurement systems: Basic Principles of transductions related to Resistive, Capacitive, Inductive, Piezoelectric, Thermoelectric and Photovoltaic.		02
b	Stages of measurement, static characteristics of instruments, and commonly used automobile and electronics components.		03
c	Electromagnetic Sensors, Optical Sensor, Temperature Sensor, Manifold Absolute Pressure Sensor, Knock Sensor, Throttle position sensor, Exhaust Gas Sensors, Air flow measurement		03

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-1 a, b, c.

Unit – II

2. Teacher should facilitate learning of

2.	Vehicle Management System	No. of Lectures - 8 Marks : 16	Lectures required
a	ABS system, its need, layout and working.		01
b	Electronic control of suspension – Damping control, Electric power steering.		01
c	Supplementary Restraint System of air bag system – crash sensor, seat belt tightening.		02
d	Cruise control, Vehicle security systems alarms, vehicle tracking system.		02
e	Collision avoidance, Radar warning system.		01
f	Introduction to Global Positioning Systems, Electronic Stability control system.		01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-2 a, b, c, d, e, f.

Unit – III

3. Teacher should facilitate learning of

3.	SI Engine Management	No. of Lectures – 8 Marks : 16	Lectures required
	a	Feedback carburetor system, throttle body injection and multi point fuel injection system, injection system controls.	02
	b	Advantage of electronic ignition systems, three way catalytic converter, conversion efficiency versus lambda.	01
	c	Layout and working of SI engine management systems like Bosch Monojetronic, L-Jetronic and LHJetronic.	01
	d	Group and sequential injection techniques. Working of the fuel system components. Advantages of electronic ignition systems.	02
	E	Types of solid state ignition systems and their principle of operation.	01
	f	Contactless electronic ignition system, Electronic spark timing control.	01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-3 a, b, c.

Unit – IV

4. Teacher should facilitate learning of

4.	CI Engine Management	No. of Lectures - 8 Marks : 16	Lectures required
	a	Fuel injection system, parameters affecting combustion,	01
	b	Noise and emissions in CI engines.	01
	c	Pilot, main, advanced, post injection and retarded post injection.	02
	d	Electronically controlled Unit Injection system. Layout of the common rail fuel injection system.	01
	e	Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter,	02
	f	EGR valve control in electronically controlled systems.	01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-4 a, b, c, d, e, f.

Unit – V

5. Teacher should facilitate learning of

5.	Automotive Electrical	No. of Lectures - 8 Marks : 16	Lectures required
	a	D.C. generator and alternator.	02
	b	Regulation for charging.	01
	c	Lighting design	01
	d	Dashboard instruments	01
	e	Horn, warning system, wiring,	01
	f	Safety devices and testing equipment.	02

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-5 a, b, c, d, e, f.

Autotronics Lab

Teacher and Examiner should follow the following guidelines.

1. Teacher should facilitate following lab experiments:

Autotronics Lab		Lab hours required
1	Demonstration and testing of auto electrical components on multifunction tester	2
2	Demonstration of head light aiming apparatus	2
3	Demonstration of dashboard panel instruments and control.	2
4	Study of throttle position sensor/ lambda sensor	2
5	Study of EGR valve control in electronically controlled systems.	2
6	Study of multi point fuel injection system	2
7	Study of Electric power steering.	2
8	Study of Electronic Stability control system.	2

Note: Lab file should contain at list six experiments from above mentioned list.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	2	14	28	1
Tutorials	--	--	--	--

Examination scheme:

End semester scheme (ESE)	25 marks
Internal Continuous Assessment (ICA)	25 marks

ESE (Oral Examination)

The Oral Examination will comprise of viva on the above Six Experiments.

References

- 1 Diesel Engine Management by Robert Bosch, SAE Publications, 3rd Edition, 2004
- 2 Gasoline Engine Management by Robert Bosch, SAE Publications, 2nd Edition,
- 3 William Harry Crouse, "Automotive Electronics and Electrical Equipment", Edition 10, Gregg Division, McGraw-Hill, 1986, ISBN 0070148953, 9780070148956
- 4 William Harry Crouse, Donald L. Anglin, "Automotive Tune up", Automotive Technology Series, Publisher McGraw-Hill Gregg Division, 1977, ISBN 0070148104, 9780070148109
- 5 Ken Layne, "Automobile Electronics and Basic Electrical Systems", Volume 1, Wiley, 1989 ISBN 0471617636, 9780471617631

Design of Machine Element (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit – I

1. Teacher should facilitate learning of

1.	Fundamental of Design	No. of Lectures - 8 Marks : 16	Lectures required
	a	Mechanical Engineering design, Aesthetic considerations in design, ergonomic consideration in design.	02
	b	Man / Machine closed loop system, Standardizations.	02
	c	Selection of material, mechanical properties of material.	02
	d	Limits, fits, tolerance, factor of safety, theories of failure.	02

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-1 a, b, c, d.

Unit – II

2. Teacher should facilitate learning of

2.	Design against fluctuating load 16	No. of Lectures - 8 Marks :	Lectures required
	a	Fluctuating stresses, S-N diagram for fatigue loading, endurance limit.	2
	b	Endurance strength Modifying factors, stress concentration, causes and remedies, notch sensitivity,	2
	c	Design of finite and infinite life under reverse stresses, cumulative damage in fatigue failure.	2
	d	Solderberg & Goodman diagram, Modified Goodman diagram, fatigue design for component such as shaft, bolted joints & springs under combined stresses.	2

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-2 a, b, c,d.

Unit – III

3. Teacher should facilitate learning of

3.	Design of shaft keys and coupling	No. of Lectures - 8 Marks : 16	Lectures required
a	Shafts: Introduction, types of shafts, design of shafts subjected to twisting moments, bending moments, combined twisting and bending moments.		3
b	Keys: Types of keys, design of keys.		2
c	Coupling: Design of rigid coupling & design of flexible coupling.		3

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-3 a, b, c.

Unit – IV

4. Teacher should facilitate learning of

4.	Design of Gears	No. of Lectures - 8 Marks : 16	Lectures required
a	<u>Spur gear</u> : Design of spur gear and helical gear, laws of gearing, terminology of spur Gear, force, analysis, face width, no. of teeth, beam strength and wear strength of gear, tooth, gear tooth failure.		3
b	<u>Helical gear</u> : Terminology of helical gear, virtual no. of teeth, tooth properties, force analysis, beam strength and wear strength		3
c	<u>Design of bevel</u> : Terminology, force analysis, beam strength and wear strength.		2

Guidelines for Paper Setters:

Theoretical and Numerical questions to be asked on Unit-4 a, b, c.

Unit – V

5. Teacher should facilitate learning of

5.	Miscellaneous design	No. of Lectures - 8 Marks : 16	Lectures required
a	Design of power screw self locking of power screws, recirculating ball screw.		3
b	Design of springs: Types application, materials of springs- stress deflection equation of helical springs, Wahl's factor, Leaf Spring.		3
c	Design of Brakes.		2

Guidelines for Paper Setters:

Theoretical & numerical questions to be asked on Unit-5 a, b, c.

Note for paper setter:

- Paper setter should provide the required data for numerical problems in question paper itself.

Note- Use of Design data book is allowed in the examination.

Design of Machine Element Lab

Teacher and Examiner should follow the following guidelines.

2. Teacher should facilitate any FIVE of the following lab practice.

S.N.	Design of machine Element Lab	Lab Hours Required
1	Design project report of screw jack	02
2	Design project report of knuckle joint	02
3	Assignment on design of spring	02
4	Assignment on design of spur gear and helical gear	02
5	Assignment on shafts, keys, and coupling	02
6	Assignment on c programming of helical compression spring	02
7	Assignment on c programming of coupling	02
8	Auto lisp-programme on knuckle joint	02

Guidelines for ICA:

ICA will based on Practical and Assignment submitted by student in form of journal. Minimum three Assignments to be submitted based on theory syllabus.

Teaching Scheme:

	Hours Per Week	No. of Weeks	Total Hours	Semester Credits
Lectures	2	14	28	1
Tutorials	--	--	--	--

Examination scheme:

End semester scheme (ESE)	25 marks
Internal Continuous Assessment (ICA)	25 marks

References

- 1 Shigley J. E. and Mischke C. R. ,“Mechanical Engineering Design”, McGraw Hill Publication Co. Ltd.
- 2 Bhandari V. B., “Design of Machine Elements”, Tata McGraw Hill Publication Co. Ltd.
- 3 Design Data”, P. S. G. College of Technology, Coimbatore.
- 4 Juvinal R.C., “Fundamentals of Machine Components Design”, John Wiley and Sons.
- 5 P. Kannaiah, “Machine Design”, Scitech publication

Transport Management and Safety Regulation (Theory)

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit – I

1. Teacher should facilitate learning of

1.	<u>Motor Vehicle Act-1989</u>		Lectures required
		No. of Lectures - 8 Marks : 16	
	a	Short Titles and definitions laws governing use of motor vehicle & vehicle transport.	01
	b	Licensing of drivers and conductor, Registration of vehicle, state and interstate permits.	01
	c	Taxation structure and methods of laving taxation, insurance type and significance.	01
	d	Furnishing particulars of vehicles involved in accident, award of claim tribunal.	01
	e	Duty of driver & conductor in case of accident, traffic rules, signals and controls, accidents causes and analysis.	01
	f	Liabilities and preventive measures, Design of road complex , Responsibility of driver , Public authorities, offences, penalties and procedures.	02
	g	Different types of forms, Government administration structure, personnel authorities and duties.	01

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-1 a, b, c, d, e, f, g.

Unit – II

2. Teacher should facilitate learning of

2.	No. of Lectures - 8 Marks : 16		Lectures required
	a	<u>Transport terminology</u> - Important terms used in road transport organization like HMV , LMV, Fleet utilization , breakdown rate, accident rate, route, seat km etc.	3
	b	<u>Cost of Services-</u> Capital cost & operating cost, fixed cost & variable cost, direct & indirect cost, excess capacity and effect on route	2
	c	<u>Operational productivity and efficiency</u> Productivity in road transportation organization, the environment of road transport system, Optimizing fleet and vehicle utilization, conservation of fuel and economy, control of breakdown, effective traffic operation	3

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-2 a, b, c.

Unit –III

3. Teacher should facilitate learning of

3.	No. of Lectures – 8 Marks : 16		Lectures required
a	<p><u>Infrastructure in road transportation organization</u> Garages, essential requirements of garages, fleet maintenance record , bus station , bus shelter, bus stop, essential requirement, staffing, management of transport organization and its of objectives, Typical depot layout structure of passages and goods transport organization</p>	4	
b	<p><u>Motor industry</u> Manufacturing techniques and quality control of automobile components such as piston, cylinder, valves, crankshaft, camshaft, bearing.</p>	4	

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-3 a, b.

Unit – IV

4. Teacher should facilitate learning of

4.	No. of Lectures - 8 Marks : 16		Lectures required
a	<p><u>Significance of Road Transportations</u> Road transportation as an agent of change and development ,National scene, transport policy and co-ordination, operating characteristics in transportation, engineering flexibility ,speed and acceleration, dependability and safety performance criteria</p>	05	
b	<p><u>Transport planning</u> Strategic planning, management control, operational control</p>	03	

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-4 a, b.

Unit – V

5. Teacher should facilitate learning of

5.	No. of Lectures - 8 Marks : 16		Lectures required
a	<p><u>Road safety and Health</u> Driving comfort, avoiding fatigue, the road to exhaustion, poisonous car fumes, car sickness, drugs & driving first aid for motorist, first aid kits, braking & stopping interpreting the signs, rain, floods, hot, mist care & precaution, ice snow skidding, emergencies & road observations.</p>	3	
b	<p><u>Accidents</u> Definition of accident, legal obligation, causes of accident, Insurance, Documentation, Analysis & preventions</p>	3	

		of accidents, Road Safety & Drivers Role , a defensive driver, driver selection test, Drivers training.	
	c	<u>Security Devices</u> Dog Restraint, Rear fog lamp, guard lamp, reversing light, bonnet, brakes locks, vibrator alarm, fog lamp, Toe bar, Roof racks, Luggage containers.	2

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-5 a, b, c.

Transport Management & Safety Regulation (Term Work)

S.N.	Transport Management & Safety Regulation (Term Work)	
	1	Collection and study of different types of R.T.O. forms.
	2	Collection and study of goods transport records.
	3	Study of accident claim and survey report.
	4	Study of depot layout (passenger & goods transport)
	5	Study of vehicle manufacturing company layout.

Guidelines for ICA:

ICA will be based on Practical and Assignment submitted by student in form of journal.
Minimum three Assignments to be submitted based on theory syllabus.

References

- 1 Government Publication, The Motor vehicle Act, 1989.
- 2 Kadiyali. L. R., Traffic engineering and Transport Planning.
- 3 P. G. Patankar, "Road passenger Transport in India", C.I.T.T. Publication
- 4 Santosh Sharma, "Productivity In Road Transportation" A.S.R.T.V. Publication
- 5 Compendium of Transport Terms- C. I. R. T. Pune

Internal Combustion Engine

Teacher, Paper setter and Examiner should follow the following guidelines.

Unit – I

1. Teacher should facilitate learning of

1.	Basic Concepts & Engine Cycles	No. of Lectures - 8 Marks : 16	Lectures required
a	Introduction: Classification, engine components and their functions, Terminology. Work (indicated and brake), mean effective pressure.		02
b	Torque and power (brake and indicated), mechanical efficiency, thermal and volumetric efficiencies of engine, air fuel ratio, specific fuel consumption.		02
c	Air Standard Cycles: Assumptions, Otto, Diesel, Dual Combustion cycle, derivation of their efficiency equation, work done and mean effective pressure.		02
d	Comparison on the basis of heat input, compression ratio, Maximum pressure and temperature, Actual cycle, deviation from theoretical cycles. Pumping losses, time losses		02

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-1 a, b, c, d.

Unit – II

2. Teacher should facilitate learning of

2.	Fuel Feeding Systems	No. of Lectures - 8 Marks : 16	Lectures required
a	Charge, intake valve and manifold, valve timing diagram, valve overlap, choked flow.		01
b	Carburetion: Requirement, types of carburetors according to fluid flow, simple carburetor, Air fuel ratio calculation,		02
c	Effect of altitude, disadvantages of simple carburetor, compensating devices for starting, economy range, acceleration, compensating jet etc. additional systems in modern carburetors, Solex carburetor. Disadvantages of carburetion and gasoline injection, MPFI.		02
d	Fuel feeding systems in CI engines: Requirement, classification, fuel feed pump, jerk type injection fuel pump, distributor type pump, injection pump governor, fuel injector and nozzles		03

Guidelines for Paper Setters:

Theoretical and numerical questions to be asked on Unit-2 a, b, c, d.

Unit –III

3. Teacher should facilitate learning of

3.	Operating System	No. of Lectures - 8 Marks : 16	Lectures required
a	Cooling systems: requirement, types of cooling systems, thermostat and additives.		02
b	b) Lubrication: Mechanism of lubrication, different methods, important properties of lubricating oils.		02
c	c) Ignition Systems: requirement, battery ignition, magneto ignition, electronic ignition system, Ignition timing, spark timing advance.		02
d	d) Starting methods of engines: Types of superchargers, Super charging, effect of super charging, limitations and advantages of supercharging, and turbo charging of engines.		02

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-3 a, b, c, d.

Unit – IV

4. Teacher should facilitate learning of

4.	Combustion in SI and CI engines	No. of Lectures - 8 Marks : 16	Lectures required
a	Homogeneous and heterogeneous mixtures, Combustion in SI engines: Stages in combustion, Ignition lag, velocity of flame propagation, factors influencing flame speed, rate of pressure rise, Detonation, factors affecting the detonation,		02
b	pre-ignition. Rating of SI engines fuels, Dopes, combustion chamber of SI engines.		02
c	Combustion in CI engine; stages of combustion, factors affecting the delay period. Diesel knock,		02
d	Effect of engine variables on Diesel knock, Rating of CI engine fuels: Cetane number, performance number, comparison of knock in SI and CI engines. Combustion chamber for CI engines.		02

Guidelines for Paper Setters:

Theoretical questions to be asked on Unit-4 a, b, c.

Unit – V

5. Teacher should facilitate learning of

5.	Engine Testing and Performance	No. of Lectures - 8 Marks : 16	Lectures required
	a	Measurement of indicated power, brake power, Morse test, energy balance and efficiency calculations.	03
	b	BIS specification. Recent trends in internal combustion engines. Engine emission, air pollution due to engines, various Euro norms,	03
	c	Unburnt hydrocarbon emission in two stroke and CI engines, CO and Nox emission, particulate traps, EGR, emission control methods catalytic converters (Introductory), crank blow by losses	02

Guidelines for Paper Setters:

Theoretical & numerical questions to be asked on Unit-5 a, b, c.

Note for paper setter:

- Paper setter should provide the required data for numerical problems in question paper itself.
- Experiment must be set simultaneously and the no. of student in each group working on a setup should not exceed 05 (five) student.

References:

- 1) V. Ganeshan, "Internal Combustion Engines", 2/e, Tata McGraw Hill, New Delhi.
- 2) R. K. Rajput, "Internal Combustion Engines", Laxmi Publications, New Delhi.
- 3) W. W. Pulkrabek, "Fundamentals of Internal Combustion Engines", Prentice Hall of India (P) Ltd., New Delhi.
- 4) E. F. Obert, "Internal Combustion Engines and Air Pollution", Harper and Row, New York.
- 5) Ferguson C. R, "Internal Combustion Engines", Wiley Inc. New York.
- 6) Sharma R.P. and Mathur M.L., "Internal Combustion Engines", Standard Publications, New Delhi.
- 7) Domkundwar, ., "Internal Combustion Engines", Dhanpat Rai & Co. New Delhi.
- 8) Willard W Pulkrabek. "Internal Combustion Engines", Pearson Education
- 9) Shyam K. Agrawal, "Internal Combustion Engines", New Edge International Publication.
- 10) K.K. Ramalingam, "Internal Combustion Engines", Scitech Publication.