



SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE

(Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai)

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DEPARTMENT OF MECHANICAL ENGINEERING

COURSE FILE

V SEMESTER

CME394 ADVANCED INTERNAL COMBUSTION ENGINEERING

(Regulation 2021-Anna University)

VEERAPANDIAN.K
Assistant Professor / MECH



SEMBODAI RUKMANI VARATHARAJAN ENGINEERING COLLEGE

Vision of Institution

Striving willfully with might to develop and nurture the younger generation to emerge as better technocrats for development of the state and the country as a whole.

Mission of Institution

Minting out skillfully competent, Socially-Committed and Versatile Knowledge personalities to encounter the challenges of the society in the field of Engineering and Technology as a whole.

DEPARTMENT OF MECHANICAL ENGINEERING

Vision of Department

To create excellent professionals in the field of Mechanical Engineering and to uplift the quality of technical education on par with the International Standards.

Mission of Department

1. To reinforce the fundamentals of Science and Mathematics to Mechanical Engineering and critically and relatively investigate complex mechanical systems and processes.
2. To engage in the production, expansion and practice of advanced engineering applications through knowledge sharing activities by interacting with global communities and industries.
3. To equip students with engineering ethics, professional roles, corporate social responsibility and life skills and apply them for the betterment of society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- I. Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.
- II. Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.
- III. To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.
- IV. To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.
- V. To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

PROGRAMME OUTCOMES (POs)

- 1 **Engineering knowledge** : Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

- 2 **Problem analysis** : Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3 **Design/development of solutions** : Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4 **Conduct investigations of complex problems** : Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5 **Modern tool usage** : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- 6 **The engineer and society** : Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7 **Environment and sustainability** : Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8 **Ethics** : Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9 **Individual and team work** : Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12 **Life-long learning** : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PEOs)

On successful completion of the Mechanical Engineering Degree programme, the Graduates shall exhibit the following:

1. Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
2. Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.
3. Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

COURSE SYLLABUS:

CME394 ADVANCED INTERNAL COMBUSTION ENGINEERING

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COURSE OBJECTIVES

- 1 To study the working of Gasoline fuel injection systems and SI combustion.
- 2 To study the working of Diesel fuel injection systems and CI combustion.
- 3 To Identifying the source and measure it; explain the mechanism of emission formation and control methods.
- 4 To study the Selecting alternative fuel resources and its utilization techniques in IC engines.
- 5 To study the advanced combustion modes and future power train systems.

UNIT – I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Mono-point, Multipoint & Direct injection -Stages of combustion – Normal and Abnormal combustion, Spark Knock, Factors affecting knock, Combustion chambers.

UNIT – II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems – Mechanical and Common Rail Direct Injection Systems - Stages of combustion – Knocking – Factors affecting knock –Direct and Indirect injection systems –Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Combustion chambers – Turbo charging – Waste Gate, Variable Geometry turbochargers.

UNIT – III EMISSION FORMATION AND CONTROL 9

Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling emissions – In-cylinder treatments – After treatment systems – Three Way Catalytic converter, Selective Catalytic Reduction, De-NOx Catalyst, Diesel Oxidation Catalyst and Particulate Traps – Methods of emission measurement – Emission norms and Driving cycles.

UNIT – IV ALTERNATIVE FUELS 9

Alcohol Fuels, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel -Properties, Suitability, Merits and Demerits – Utilisation Methods - Engine Modifications.

UNIT – V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM 9

Low Temperature Combustion - Homogeneous charge compression ignition (HCCI) – Reactivity Controlled Compression Ignition (RCCI) – Gasoline Compression Ignition – Spark Assisted HCCI - Hybrid Electric and Electric Vehicles – Fuel Cells.

TOTAL 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the working of Gasoline fuel injection systems and SI combustion.
2. Explain the working of Diesel fuel injection systems and CI combustion.
3. Identify the source and measure it; explain the mechanism of emission formation and control methods.
4. Select alternative fuel resources and its utilization techniques in IC engines.
5. Explain advanced combustion modes and future power train systems.

TEXT BOOKS:

1. V. Ganesan, "Internal Combustion Engines", V Edition, Tata McGraw Hill, 2012.
2. John B. Heywood, "Internal Combustion Engines Fundamentals", McGraw-Hill, 1988.

REFERENCES:

1. B.P. Pundir, "IC Engines Combustion & Emission", Narosa Publishing House, 2014.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Wilcox Company, Inc., 2003.
3. EranSher, Handbook of Air Pollution from Internal Combustion Engines: Pollutant Formation and Control, Academic Press, 1998.
4. K.K. Ramalingam, "Internal Combustion Engine Fundamentals", SciTech Publications, 2011.
5. R.B. Mathur and R.P. Sharma, "Internal Combustion Engines", Dhanpat Rai& Sons, 2007

QUESTION BANK

Subject : CME 394– ADVANCED IC ENGINEERING

Year / Sem : III / V

UNIT I- SPARK IGNITION ENGINE

Mixture requirements – Fuel injection systems – Mono point, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

PART-A

Q.No.	Questions	BT Level	Competence	PO
1	What is a heterogeneous air-fuel mixture? In which engine is it used?	BTL-1	Remembering	PO5
2	What is the principle of carburetor?	BTL-1	Remembering	PO5
3	Define abnormal combustion and its consequences?	BTL-1	Remembering	PO3
4	What is equivalence ratio?	BTL-1	Remembering	PO5
5	Short note on SI engine equivalence ratio requirements?	BTL-4	Analyzing	PO1
6	Write the desirable qualities for SI engine fuel?	BTL-1	Remembering	PO1
7	Explain the type of vibration produced when auto ignition occurs.	BTL-4	Analyzing	PO4
8	What is the method to detect the phenomenon of knocking?	BTL-1	Remembering	PO1
9	List out some of the knock limited parameters?	BTL-1	Remembering	PO5
10	List out some of the knock limited parameters?	BTL-5	Evaluating	PO1
11	List the factors that are involved in either producing(or)preventing knock	BTL-2	Understanding	PO5
12	List the parameters which are affecting knock in SI engine?	BTL-1	Remembering	PO5
13	List the parameters in time factors that reduce the knocking?	BTL-1	Remembering	PO3
14	List the composition factors in the knocking?	BTL-1	Remembering	PO5
15	What are the objectives to be kept in mind during design of combustion chamber?	BTL-1	Remembering	PO5
16	What are the factors to be considered to obtain high thermal efficiency?	BTL-1	Remembering	PO5
17	Write the different types of combustion chambering SI engine?	BTL-1	Remembering	PO6

18	What are the components required in the fuel injection system?	BTL-1	Remembering	PO6
19	What are the advantages of fuel-injection in an SI engine?	BTL-1	Remembering	PO10
20	List the draw backs of the carburetion?	BTL-1	Remembering	PO1
21	What is the functional requirement so fan injection system?	BTL-1	Remembering	PO5
22	List some of the important requirements of an automobile carburetor?	BTL-1	Remembering	PO5
23	What are the general types of carburetors?	BTL-1	Remembering	PO5
24	What are the essential parts, compensating device and additional system (Modern) carburetors?	BTL-1	Remembering	PO5
25	Define carburetion?	BTL-1	Remembering	PO5
26	What are the factors effecting carburetion?	BTL-1	Remembering	PO1
27	What are the different types air-fuel mixtures?	BTL-2	Understanding	PO1
28	What are the different range of throttle operation	BTL-1	Remembering	PO5
29	Function of carburetor?	BTL-1	Remembering	PO6
30	Define Heat Engine?	BTL-1	Remembering	PO4

PART-B&PART-C

1	Discusses why a modern carburetor is being replaced by an injection system in SI engine?	BTL-6	Creating	PO1
2	Explain the factors that affect the process of carburetion?	BTL-2	Understanding	PO5
3	What are different air-fuel mixtures on which an engine can be operated?	BTL-1	Remembering	PO5
4	Explain the following; 1.Richmixture, 2.Stoichiometric mixture3. Lean mixture.	BTL-6	Creating	PO1
5	How the power and efficiency of the SI engine vary with air- fuel ratio for different load and speed conditions?	BTL-2,	Understanding	PO1
6	Explain why a rich mixture is required for the following1.Idling2.Maximumpower and sudden acceleration.	BTL-2, BTL-5	Understanding	PO5



UNIT II COMPRESSION IGNITION ENGINES

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbo charging.

PART-A

Q. No.	Questions	BT Level	Competence	PO
1	Mention any two advantages of induction swirl	BTL-1	Remembering	PO5
2	What is ignition delay period?	BTL-1	Remembering	PO5
3	What are two delay occur in ignition delay period?	BTL-1	Remembering	PO3
4	List the factors affecting the delay period?	BTL-1	Remembering	PO5
5	Explain the effect of quality of fuel factor on the delay period?	BTL-4	Analyzing	PO1
6	Give a comparative statement various characteristics that reduces knock in S.I and C.I engine (any four)?	BTL-1	Remembering	PO1
7	Write the classification of combustion chamber in C.I engine?	BTL-1	Remembering	PO4
8	What is called direct injection type of combustion chamber?	BTL-2	Understanding	PO1
9	What are the types of open combustion chamber?	BTL-2	Understanding	PO5
10	What are the advantages and disadvantages of open combustion chamber type?	BTL-1	Remembering	PO1
11	What is indirect injection type of combustion?	BTL-1	Remembering	PO5
12	Write the classification of indirect injection chamber (divided combustion chamber)	BTL-1	Remembering	PO5
13	What are the applications of swirl chamber?	BTL-1	Remembering	PO3
14	List the advantages and draw backs of indirect	BTL-2	Understanding	PO5
15	Why specific fuel consumption is high in indirect injection type combustion	BTL-1	Remembering	PO5
16	What is turbo charging?	BTL-1	Remembering	PO5
17	What are the major parts of a turbocharger?	BTL-1	Remembering	PO6
18	Explain the term turbo lag.	BTL-1	Remembering	PO6
19	Explain the function of waste gate.	BTL-1	Remembering	PO10
20	Why there is a large pressure differences a cross the injector nozzle are required:	BTL-1	Remembering	PO1
21	What is called breakup length?	BTL-1	Remembering	PO5

22	What are the different designs of nozzle used?	BTL-1	Remembering	PO5
23	What are the two types of photographic technique used?	BTL-1	Remembering	PO5
24	Explain photographic techniques method:	BTL-1	Remembering	PO5
25	List the droplet size depends on various factors:	BTL-1	Remembering	PO5
26	Define flame development angle:	BTL-1	Remembering	PO1
27	Define rapid burning angle:	BTL-1	Remembering	PO1
28	List the factors that are involved in either producing (or) preventing knock.	BTL-1	Remembering	PO5
29	List types of nozzle?	BTL-1	Remembering	PO6
30	What are consideration should doing assemble of fuel injections?	BTL-1	Remembering	PO4
Q. No.	Questions	BT Level 1	Competence	PO5

PART-B&PART-C

1	Bring out clearly the process of combustion in CI engines and also explain the various stages of combustion. What is delay period and what are the factors that affect the delay period?	BTL-2	Understanding	PO3
2	Explain Turbo charging in CI engines	BTL-2	Understanding	PO5
3	Explain with neat sketch about the air ventilation.	BTL-2	Understanding	PO1
4	What are the effects of turbo charging on CI engines?.	BTL-2 BTL-5	Understanding Evaluating	PO1
5	What are the main factors affecting the penetration of the fuel spray in CI engines?	BTL-6	Creating	PO4



UNIT III - EMISSION FORMATION AND CONTROL

Pollutant – Sources – Formation of Carbon Monoxide, Un burnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles

PART-A

Q. No.	Questions	BT Level 1	Competence	PO5
1	Why smoke is formed in a CI engine?	BTL-1	Remembering	PO3
2	State the significance of stoichiometric air-fuel mixture?	BTL-1	Remembering	PO5
3	What are the major exhaust emissions?	BTL-1	Remembering	PO5
4	What are the causes for hydrocarbon emission from S.I engine?	BTL-1	Remembering	PO5
5	What are the reasons for incomplete combustion in SI engine?	BTL-1	Remembering	PO6
6	What are the reasons for flame quenching?	BTL-1	Remembering	PO6
7	How the oil consumption increases in IC engines and what are the effects?	BTL-1	Remembering	PO10
8	Write a short note on carbon monoxide emissions.	BTL-1	Remembering	PO1
9	What is photochemical smog?	BTL-2	Remembering	PO5
10	What are soot particles?	BTL-1	Remembering	PO5
11	What is the most effective after treatment for reducing engine emissions?	BTL-1	Remembering	PO5
12	List the materials used as catalyst	BTL-1	Remembering	PO5
13	Why catalytic converter called as three way converters?	BTL-1	Remembering	PO5
14	What are the types of ceramic structure used in catalytic converter?	BTL-1	Remembering	PO1
15	What is a catalyst?	BTL-1	Remembering	PO1
16	List out the drawbacks of catalytic converters	BTL-1	Remembering	PO5
17	What are the methods of catalytic converter superheating?	BTL-1	Remembering	PO6
18	List the invisible and visible emission	BTL-1	Remembering	PO4
19	What are the methods of measuring the following emission?	BTL-1	Remembering	PO5

20	Effect of catalytic converters?	BTL-1	Remembering	PO5
21	short note on hc and carbon monoxide emissions ?	BTL-1	Remembering	PO3
22	Function of turbo charging?	BTL-1	Remembering	PO5
23	Methods of controlling emissions?	BTL-1	Remembering	PO1
24	Explain EGR?	BTL-1	Remembering	PO1
25	What is particulate traps?	BTL-1	Remembering	PO4
26	How photochemical smog produce?	BTL-1	Remembering	PO1
27	What is SOF?	BTL-1	Remembering	PO5
28	What is evaporative emission	BTL-1	Remembering	PO1
29	Define crankcase blow by?	BTL-6	Creating	PO5
30	What are the method to find performance of engine ?	BTL-1	Remembering	PO5

PART-B & PART-C

Q. No.	Questions	BT Level	Competence	PO
1	Describe in detail the causes of hydro carbon emissions from SI engines..	BTL-2	Understanding	PO5
2	What are catalytic converters? How are they help full in reducing HC,CO and NOx emissions?	BTL-2	Understanding	PO5
3	Give a brief account of emissions from CI engines.	BTL-6	Creating	PO5 ,PO1
4	Explain the inter nationally accepted method so measuring the following in visible emission	BTL-2	Understanding	PO5
5	i) Oxides of nitrogen (ii) Carbon monoxide (iii) Unburned hydrocarbons	BTL-2	Understanding	PO5 ,PO1
6	What is smoke and classify the measurement of smoke?	BTL-6	Creating	PO1 ,PO5

UNIT IV ALTERNATIVE FUELS

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

PART-A

Q.No.	Questions	BT Level	Competence	PO
1	Write the advantage and disadvantage of alcohol as a fuel?	BTL-1	Remembering	PO5
2	What is the problem with gasoline-alcohol mixture as a fuel?	BTL-1	Remembering	PO5
3	Write the sources for methanol?	BTL-2	Understanding	PO3
4	Write the source for ethanol?	BTL-1	Remembering	PO5
5	What are the techniques of using alcohol in diesel engine fuel?	BTL-5	Evaluating	PO1
6	What are the methods adopted for induction of alcohol into intake manifold?	BTL-1	Remembering	PO1
7	List the advantages of hydrogen as an IC engine?	BTL-5	Evaluating	PO4
8	List the disadvantages of using hydrogen as a fuel?	BTL-1	Remembering	PO1
9	Write the methods for hydrogen can be used in SI engines?	BTL-1	Remembering	PO5
10	List the advantages and disadvantages of natural gas?	BTL-1	Remembering	PO1
11	Write the two types of LPG used in automobiles engine?	BTL-1	Remembering	PO5
12	What are the advantages of LPG?	BTL-2	Understanding	PO5
13	Write the disadvantages of LPG?	BTL-1	Remembering	PO3
14	Write the improvements required for the LPG vehicle in future?	BTL-2	Understanding	PO5
15	Compare the petrol and LPG?	BTL-1	Remembering	PO5
16	Write any two Advantages of alcohol.	BTL-2	Understanding	PO5
17	Disadvantages of alcohol.	BTL-1	Remembering	PO6
18	Techniques of using alcohol in diesel engine?	BTL-1	Remembering	PO6
19	Advantages of hydrogen.	BTL-1	Remembering	PO10



20	Disadvantage of hydrogens.	BTL-2	Understanding	PO1
21	What are all the methods can be used hydrogen as S.I engine fuels?	BTL-1	Remembering	PO5
22	List the benefits of natural gas?	BTL-1	Remembering	PO5
23	Write down three phases of shop floor control	BTL-1	Remembering	PO5
24	What are all the methods can be used hydrogen as S.I engine fuels?	BTL-1	Remembering	PO5
25	List the benefits of natural gas?	BTL-1	Remembering	PO5
26	Demerits of LPG?	BTL-1	Remembering	PO1
27	What is dual fuel operation?	BTL-1	Remembering	PO1
28	Define Indicator diagram?	BTL-1	Remembering	PO5
29	Willan's line Method?	BTL-1	Remembering	PO6
30	What is Morse test?	BTL-1	Remembering	PO4

PART-B& PART-C

1	Explain the reasons for looking for alternate fuels for IC engines.	BTL-2	Understanding	PO9, PO5, PO1
2	Explain alcohols as alternate fuels for IC engines bringing out their merits and demerits.	BTL-1	Remembering	PO5
3	Explain the possibility of using reformulated gasoline and water gasoline mixture as alternate fuel.	BTL-2	Understanding	PO1,P O5
4	Can alcohol be used for CI engines? Explain	BTL-2	Understanding	PO5, PO1
5	Explain with a neat sketch the surface-ignition alcohol engine	BTL-6	Creating	PO5
6	What are the advantages and disadvantages of using hydrogen in SI engine.	BTL-2	Understanding	PO1,P O5

UNIT V ALTERNATE COMBUSTION AND POWER TRAIN SYSTEM

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics.

PART-A

Q.No.	Questions	BT Level	Competence	PO
1	What is lean burn engine?	BTL-1	Remembering	PO5
2	Why lean mixture is preferred in SI engine?	BTL-1	Remembering	PO5
3	What are the modifications to be made to convert	BTL-1	Remembering	PO3

	an existing engine as a lean burn engine?			
4	How the stratified charge engine can be characterised?	BTL-1	Remembering	PO5
5	List the advantages of the stratified charge engine.	BTL-1	Remembering	PO1
6	What are the main disadvantages of the stratified charge engine?	BTL-1	Remembering	PO1
7	Write short notes on plasma jet ignition system.	BTL-1	Remembering	PO4
8	What are the factors that influence the operation of the plasma jet plug?	BTL-1	Remembering	PO1
9	What are there a sons for automotive engines equipped with gasoline injection system?	BTL-1	Remembering	PO5
10	What are the types of injection system?	BTL-1	Remembering	PO1
11	What are the objective of the fuel injection system?	BTL-1	Remembering	PO5
12	What are the components of injection system?	BTL-1	Remembering	PO5
13	Write notes on continuous injection system.	BTL-1	Remembering	PO3
14	Explain the functions of the following components. (a) Pumping element, (b) Metering element, (c) Timing control, (d) Ambient control.	BTL-1	Remembering	PO5
15	Write the advantages of homogeneous charge compression ignition engine?	BTL-1	Remembering	PO5
16	What are the fuel s used in HC CI engines?	BTL-1	Remembering	PO5
17	List the disadvantages of homogeneous charge compression ignition engine?	BTL-1	Remembering	PO6
18	What is the chemical formula for diesel, ethanol, methanol and LPG	BTL-6	Creating	PO6
19	define charge stratification?	BTL-1	Remembering	PO10
20	Mention the advantages of plasma ignition system	BTL-1	Remembering	PO1
21	Mention the advantages of plasma ignition system	BTL-1	Remembering	PO5
22	What is the working principle of pre chamber stratified charge engine?	BTL-1	Remembering	PO5
23	What is multi valve engine?	BTL-1	Remembering	PO5
24	Explain data acquisition system.	BTL-1	Remembering	PO5
25	Explain gasoline direct injection engine	BTL-1	Remembering	PO5
26	Explain briefly plasma–jet ignition system.	BTL-1	Remembering	PO1
27	Classification of ignition systems.	BTL-1	Remembering	PO1
28	what is direct ignition chamber type	BTL-1	Remembering	PO5
29	indirect ignition chamber	BTL-1	Remembering	PO6
30	what is direct frictional losses	BTL-1	Remembering	PO4
PART-B& PART-C				
1	What is the necessity for gasoline injection? Explain with suitable sketch.	BTL-2	Understanding	PO5, PO6,

				PO7
2	With neat sketch, explain the exhaust emissions with different air-fuel ratio lean burn spark ignition engines.	BTL-2	Understanding	PO5, PO6, PO7
3	What do you understand by charge stratification ? Explain the method of achieving the same with suitable sketches. Discuss the advantages and disadvantages of charge stratification.	BTL-2	Understanding	PO5, PO6, PO7
4	Explain briefly plasma-jet ignition system	BTL-2	Understanding	PO5, PO6, PO7
5	What is a lean burn engine? What are the advantages of using lean mixture in SI engine?	BTL-2	Understanding	PO5, PO6, PO7
6	Explain the characteristics of Homogeneous charge compression ignition engine	BTL-2	Understanding	PO5, PO6, PO7

