MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Estd. 2000

IQAC

MUST KNOW CONCEPTS	MKC
MECH	2020-21

Course Code & Course Name : 16MEE03 & Advanced I.C Engines

Year/Sem/Sec : IV/VII/B

S.No.	Term	Notation (Symbol)	Concept/Definition/Meaning/ Units/Equation/Expression	Units
Unit-I : Introduction				
1.	Engine	---	The part of a vehicle that produces power to make the vehicle move.	
2.	Heat Engine	---	A heat engine is a device which transforms the chemical energy of a fuel into thermal energy	
3.	Types of Heat Engine	---	(a) External combustion engine (b) Internal combustion engine	
4.	External Combustion Engine	---	In this engine, the products of combustion of air and fuel transfer heat to a second fluid which is the working fluid of the cycle.	
5.	Internal Combustion Engine	---	In this engine, the combustion of air and fuels take place inside the cylinder and are used as the direct motive force.	
6.	Components of Reciprocating IC Engine	---	1. Cylinder 2. Piston 3. Connecting rod 4. Crankshaft 5. Crank case 6. Flywheel	
7.	Types of Four Stroke Engine	---	1. Suction stroke 2. Compression stroke 3. Expansion stroke 4. Exhaust stroke	
8.	Combustion	---	The process of burning.	
9.	Types of Combustion	---	a) Normal Combustion b) Abnormal Combustion	
10.	Normal and Abnormal Combustion	---	**Normal combustion** is initiated towards the end of the compression stroke at the spark plug by an electric discharge **Abnormal combustion** in spark ignition engine majorly occurs as knock and surface ignition.	
11.	Piston	---	Cylindrical component fitted into cylinder forming the moving boundary of the combustion system.	

12.	Connecting Rod	---	Interconnects the piston and crankshaft.	
13.	Crankshaft	---	Major engine component which converts the reciprocating motion of the piston into rotary motion.	
14.	Camshaft	---	Receives the drive from crankshaft and control the valve opening.	
15.	Valve	---	To admit the air-fuel mixture in engine cylinder and discharging the products of combustion from cylinder.	
16.	Carburetor	---	Atomizes the fuel and mixes it with air.	
17.	Unit Injector	---	Combination of high pressure pumps and injectors in one unit.	
18.	Ignition system	---	Produce spark in injection cylinder towards the end of the compression stroke.	
19.	Smog	---	Mixture of particles of unburnt fuel and the air.	
20.	Knock	---	Knock is the auto ignition of the portion of Fuel, air and residual gas mixture ahead of the advancing flame that produces noise.	
21.	Surface Ignition	---	Surface ignition is ignition of the fuel air charge by overheated valves or spark plugs.	
22.	Catalytic Converter	---	Harmful gases converted into Harmless gases.	
23.	Effect of engine variables on flame propagation	---	1. Air fuel ratio 2. Compression ratio 3. Load on engine 4. Turbulence and engine speed 5. Other factors	
24.	Detonation	---	Combustion of a substance which is initiated suddenly and propagates extremely rapidly, giving rise to a shock wave.	
25.	Effect of engine operating variables on the engine knocking	---	a) Temperature Factor b) Density Factor c) Time Factor d) Composition Factor	
Unit-II : COMPRESSION IGNITION ENGINES				
26.	Types of diesel injection system	---	a) Air injection system b) Solid injection system c) jerk pump system d) Common rail system e) Distributor system	
27.	Blast injector	---	These are superseded by mechanically operated injectors used in air injection system	
28.	Multi-hole nozzle	---	Number of hole varies from 4 to 18 and the size from 1.5 to 0.35 mm and the injection rate is not uniform	
29.	Single hole nozzle	---	It is used in open combustion chamber. The size of hole larger than 0.2 mm and very high injection pressure is required	

30.	Turbocharger	---	By utilizing the exhaust energy to drive the gas turbine.	
31.	Supercharger	---	Increase the air density for maximize the power output	
32.	Types of Combustion Chamber	---	1. Direct Injection (or) open Injection Type 2. Indirect Injection Type	
33.	Types of open combustion chamber	---	1. Shallow Depth Chamber 2. Hemispherical Chamber 3. Cylindrical Chamber 4. Toroidal Chamber	
34.	Important fuel specifications for diesel	---	a) Viscosity b) Surface tension c) Cetane number	
35.	Surface Tension	---	The Surface tension is a parameter which effects the formation of fuel droplets in sprays.	
36.	Cetane number	---	50 - 60 for high speed Diesel engines 25 - 45 for low speed Diesel engines Normal diesel fuel CN is 40-50	
37.	Atomization	---	It refers to separating something into fine particles. It is a process of breaking bulk liquids into small droplets.	
38.	Stages of combustion in C.I Engine	---	Stage 1: Ignition delay period Stage 2: Period of rapid combustion. Stage 3: Period of controlled combustion. Stage 4: Period of after burning.	
39.	Factors Affecting the delay period	---	1. Compression ratio 2. Atomization of the fuel 3. Quality of the fuel 4. Intake temperature and pressure	
40.	Applications of swirl chamber	---	a. Where fuel quality is difficult to control b. Where reliability under adverse condition is more important than fuel economy	
41.	Parts of Turbocharger	---	a) Turbine Wheel, b) Turbine Housing, c) Turbo Shaft, d) Compressor Wheel, e) Compressor Housing And f) Bearing Housing.	
42.	Turbo Lag	---	It refers to the short delay period before the boost or manifold pressure increase .	
43.	Flame development angle	---	The crank angle interval between the spark discharge and the time when a small but significant fraction of the cylinder mass has burned or fuel chemical energy has been released	
44.	Rapid burning angle	---	The crank angle interval required to burn the bulk of the charge is defined as the interval between the end of the flame development stage and the end of the flame propagation process.	
45.	Parameters of Macroscopic Characteristics	---	1.Spray tip penetration 2.Spray angle 3.Break up length	

46.	Factors Influence Spray Penetration in CI Engines	---	a) Spray Formation b) Spray Characteristics c) Spray Penetration d) Spray Direction	
47.	Oxygen concentration	---	Residual gases reduce O_2 concentration and reducing oxygen concentration increases ID.	
48.	Surface Ignition	---	Surface ignition is ignition of the fuel air charge by overheated valves or spark plugs.	
49.	Knock	---	Knock is the auto ignition of the portion of Fuel, air and residual gas mixture ahead of the advancing flame that produces noise.	
50.	Types of Combustion	---	c) Normal Combustion d) Abnormal Combustion	
Unit-III : POLLUTANT FORMATION AND CONTROL				
51.	Exhaust Emissions	---	Internal combustion engines operate by burning of the fossil fuel derivatives. The exhaust emissions are the major contribution to environmental pollution.	
52.	Major exhaust emissions	---	1.Unburnt gas 2.Oxides of carbon (co and co2) 3.Oxides of nitrogen (NO and NO2) 4.Oxides of Sulphur (SO2 and SO3)	
53.	Mechanism of NO formation	---	The nitric oxide formation during the combustion process is the result of group of elementary reactions involving the nitrogen and oxygen.	
54.	Simple reaction (N2 O2)	---	$N2 + O2 \rightarrow 2NO$	
55.	Zelodovich chai reaction mechanism	---	$O2 \rightarrow 2O$ $O+N2 \rightarrow NO+N$ $N+O2 \rightarrow NO+O$	
56.	Hydrocarbons formations	---	Wall quenching, Incomplete combustion of fuel, Exhaust scavenging in 2-stroke engines.	
57.	Wall quenching	---	The quenching of the flame near the combustion chamber walls is known as the wall quenching.	
58.	Incomplete combustion	---	Under the operating conditions, where mixtures are extremely rich or lean or exhaust gas dilution is excessive, incomplete flame propagation's occurs during the combustion is called incomplete combustions	
59.	Factors of Incomplete combustion	---	1.Poor condition of ignition system including spark plug 2.Low charge temperature 3.Too rich or lean mixture in cylinder	
60.	Scavenging	---	In 2-stroke engine a third source of HC emission results from scavenging of the cylinder with fuel air mixture.	
61.	Carbon monoxide's formation	---	Carbon monoxide remains in the exhaust if the oxidation of the CO and CO2 is not complete it	

			is an intermediate part of the combustion process.	
62.	Diesel engine smoke emission	---	Engine exhaust smoke is a visible indicator of the combustion process in the engine. Smoke is due to incomplete combustion.	
63.	Types of diesel engine smoke	---	1. blue smoke 2. white or cold smoke 3. black or cold smoke	
64.	Blue smoke	---	It results from the burning of engine lubricating oil that reaches combustion chamber due the worn piston rings, cylinder liners and valve guides	
65.	White or cold smoke	---	It is made up of the droplets of unburnt or partially burnt fuel droplets and is usually associated with the engine running at the less than the normal operating temperature after starting.	
66.	Black or hot smoke	---	It is consisting of unburnt carbon particles (0.5”1 micron in diameter) and other solid products of combustion.	
67.	Particulate’s	---	Particulate’s matter comes from the hydrocarbons, lead additives and Sulphur dioxide. Very harmful to humans, animals, plants, and nature.	
68.	Particulate’s formations	---	Organic and inorganic compounds of higher molecular weights and lead compounds resulting from the use of TEL are exhaust gas from the CI/SI engines. Size of particles (0.02 to 0.06).	
69.	Greenhouse effects	---	The greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmosphere greenhouse re-radiation in all directions.	
70.	Greenhouse gases	---	Water vapor 36-70% Carbon dioxide 9-26% Methane 4-9% Ozone 3-7%	
71.	Catalysts	---	A catalyst is a substance that accelerates chemical reaction by lowering the energy needed for it to proceed.	
72.	Material used in catalyst	---	1. Platinum 2. Palladium 3. Rhodium	
73.	Methods of measuring emissions	---	1. Oxides of nitrogen 2. Carbon monoxide 3. Unburned hydrocarbons	
74.	Invisible emissions	---	Water vapor, carbon dioxide, oxides of nitrogen, unburnt hydrocarbons	
75.	Visible emissions	---	Smoke, particulate.	
Unit-IV : : ALTERNATIVE FUELS				
76.	Bio-Diesel	---	Non-petroleum based diesel fuel consists of mono alkyl esters derived from vegetable oil and	

			animal fats.	
77.	Bio-gas	---	Gaseous fuel of varying proportions of methane, co_2, water vapour etc..	
78.	B-100	---	100% Bio-Diesel	
79.	Gasohal	---	90% gasoline with 10% anhydrous ethanol.	
80.	ethanol mixture	---	5 % anhydrous ethanol and 15 % gasoline.	
81.	Hybrid vehicle	---	Using two or more distinct power sources.	
82.	Fuel cell	---	Produces electricity through a chemical reaction, but without combustion.	
83.	Fuel cell parts	---	Anode, Cathode, Electrolyte and Fuel.	
84.	LPG	---	Liquified Petroleum Gas	
85.	CNG	---	Compressed Natural Gas, methane stored at high pressure.	
86.	Sources of methanol	---	coal, petroleum, natural gas, biomass, wood landfills and even theocean.	
87.	Sources of ethanol	---	Sugarcane, sugarbeets, and even cellulose (wood and paper).	
88.	Techniques of using alcohol	---	Alcohol dieselemulsions, Dual fuel injection, Alcohol fumigation, Surface ignition of alcohols.	
89.	Advantages of using hydrogen	---	Lowemissions, Fuelavailability, Fuel leakage to environment is not apollutant High energy continent per volume when stored as aliquid.	
90.	Disadvantages of using hydrogen	---	Difficult to re fuel,Fuel cost would be high at present day's technology andavailability,Poor engine volumetricefficiency,High NOx emission because of highflame.	
91.	Methods for hydrogen usage in IC engine	---	By manifoldinduction, By direct introduction of hydrogen into thecylinder,By supplementinggasoline.	
92.	Types of LPG	---	One is propane and the other is butane	
93.	Advantages of LPG	---	LPG mixes with air at all temperatures. LPG has high antiknock characteristics. There is no crack case dilution, because the fuel is in the form of vapor.	
94.	Disadvantages of LPG	---	A special fuel feed system is required for liquid petroleum gas. A good cooling system is quite necessary. The vehicle weight is increased due to the use of heavy pressure cylinder for storing LPG	
95.	Piston	---	Cylindrical component fitted into cylinder forming the moving boundary of the combustion system.	
96.	Connecting rod	---	Interconnects the piston and crankshaft.	
97.	Crankshaft	---	Major engine component which converts the reciprocating motion of the piston into rotary	

			motion.	
98.	Camshaft	---	Receives the drive from crankshaft and control the valve opening.	
99.	Valve	---	To admit the air-fuel mixture in engine cylinder and discharging the products of combustion from cylinder.	
100.	Sources of Methanol	---	Sugarcane, sugarbeets, and even cellulose (wood and paper).	
Unit-V : RECENT TRENDS				
101.	Carburetor	---	Atomizes the fuel and mixes it with air.	
102.	Ignition system	---	Produce spark in injection cylinder towards the end of the compression stroke.	
103.	Unit Injector	---	Combination of high pressure pumps and injectors in one unit.	
104.	Supercharger	---	Increase the air density for maximize the power output	
105.	Turbocharger	---	By utilizing the exhaust energy to drive the gas turbine.	
106.	Catalytic Converter	---	Harmful gases converted into Harmless gases.	
107.	EURO NORMS	---	Permissible emission levels which have been implemented in Europe.	
108.	Smog	---	Mixture of particles of unburnt fuel and the air.	
109.	Clutch	---	Connect or disconnect the power transmission.	
110.	Gear box	---	Regulate both the power output and the speed range.	
111.	Tractive effort	---	Driving force at driving wheel to propel the vehicle.	
112.	Fluid flywheel	---	Hydraulic unit that replaces a clutch and transmits the engine torque to transmission system.	
113.	Hotchkiss drive	---	Open propeller shaft, in which the torque reaction is taken by the springs.	
114.	Differential	---	Drives the outer wheel faster than the inner wheel while in turn.	
115.	Live axle	---	Turns within a tubular housing.	
116.	Dead axle	---	Solid axle mounted on springs with a spindle at each end.	
117.	Power Steering	---	Operating the steering by using the compressed air or hydraulic pressure.	
118.	Braking system	---	Reduce the speed, stop the moving vehicle and to hold the vehicle.	
119.	Independent suspension	---	Mounting of the wheel on a separate axle.	
120.	Wishbone	---	Triangular steel frame which connects vehicle body to each wheel in independent suspension system.	
121.	Antilock Braking	---	Relieving the brake pressure momentarily to	

	System		prevent locking of wheel.	
122.	Volatility	---	Evaporating tendency of a liquid fuel.	
123.	Flame speed	---	The speed at which flame travels inside the combustion chamber.	
124.	Pumping element	---	moves the fuel from the fuel tank to the injector. This include necessary piping, filter etc.	
125.	Timing control	---	fixes the start and stop of the fuel-air mixing process.	
Placement Questions				
126.	How many times are the hands of a clock at right angle in a day?		A. 22 B. 24 **C. 44** D. 48 Explanation: In 12 hours, they are at right angles 22 times. ∴ In 24 hours, they are at right angles 44 times.	
127.	A train moves with a speed of 108 kmph. Its speed in metres per second is :		A.10.8 B.18 **C.30** D.38.8 Explanation:108 kmph = 108*[5/18] m/sec = 30 m/s.	
128.	Determine the probability that a digit chosen at random from the digits 1, 2, 3, …12 will be odd.		Total no. of Digits = 12. Equally likely cases = 12. There are six odd digits. Probability = 6 / 12 = 1 / 2	
129.	In covering a distance of 40 km, Kamlesh takes 2 hours more than Pankaj. If Kamlesh doubles his speed, then he would take 1 hour less than Pankaj. Then what is Kamlesh's speed?		A. 11 kmph **B. 5 kmph** C. 9 kmph D. 6 kmph Answer:B Explanation: Let Kamlesh's speed be x km/hr. Then, `40/x - 40/(2x) = 4` 8x = 40 x = 5 km/hr	
130.	Solve the equation x+34=82		A. 58 **B. 48** C. 55 D. 60 Explanation: x=82-34=48	
131.	An accurate clock shows 8 o'clock in the morning. Through how may degrees will the hour hand rotate when the clock		A.360. **B.180** C.90 D.60 Answer: B) 180 Explanation: Angle traced by the hour hand in 6	

	shows 2 o'clock in the afternoon?		hours=(360/12)*6	
132.	Excluding stoppages, the speed of a bus is 54 kmph and including stoppages, it is 45 kmph. For how many minutes does the bus stop per hour?		A. 9 **B. 10** C. 12 D. 20 Explanation: Due to stoppages, it covers 9 km less. Time taken to cover 9 km = $\frac{9}{54} \times 60$ min = 10 min.	
133.	Find the no., when 15 is subtracted from 7 times the no., the result is 10 more than twice of the number		Let the number be x. 7x -15 = 2x + 10 => 5x = 25 => x = 5	
134.	If 0.75: x :: 5:8, then x is equal to:		A.1.12 B.1.16 **C.1.20** D.1.30 Explanation:(x * 5) = (0.75 *8) X=6/5 = 1.20	
135.	Today is Monday. After 61 days, it will be :		A. Tuesday B. Monday C. Sunday **D. Saturday** Answer: D) Saturday Explanation: Each day of the week is repeated after 7 days. So, after 63 days, it will be Monday. After 61 days, it will be Saturday.	
136.	Adam can do a job in 15 days; Eve can do the same job in 20 days. If they work together for 4 days, what fraction of job is incomplete?		Adam can do 1/15 of the job per day Eve can do 1/20 of the job per day If they work together they can do 7/60 of the work together Remaining job 1 - 7/60 = 32/60 = 8/15	
137.	Which one of the following is not a prime number?		A.31 B. 61 C. 71 **D. 91** Explanation: 91 is divisible by 7. So, it is not a prime number.	
138.	Find c, if 5c - 2 = 33		**A. 7** B. 9 C. 11 D. 13 Explanation: We add 2 to both sides and get 5c-2+2=33+2, or 5c=35. We divide both sides by 5 to get c=7.	
139.	A person crosses a 600 m long street in 5 minutes. What is		A. 3.6 **B. 7.2** C. 8.4	

	his speed in km per hour?		D. 10 Explanation: Speed = 600/ 5 x 60 m/sec. = 2 m/sec. = 2 x 18/5km/hr =7.2 km/hr	
140.	A and B can do a piece of work in 4 days, while C and D can do the same work in 12 days. In how many days will A, B, C and D do it together?		A, B, C and D will together take ¼ + 1/12 = 4/12 = 1/3. 3 days to complete the work.	
141.	The average of five numbers is 27. If one number is excluded, the average becomes 25. The excluded number is?		A.25 **B.35** C.45 D.55 Answer:B Explanation: (27*5)-(25*4) 135-100 35	
142.	The maximum gap between two successive leap year is?		A.4 **B.8** C.2 D.1 Answer: B) 8 Explanation: This can be illustrated with an example. Ex: 1896 is a leap year. The next leap year comes in 1904 (1900 is not a leap year).	
143.	A guy bought 10 pencils for Rs. 50 and sold them for Rs. 60.What is his gain in terms of percentage?		A. 10% B. 5% **C. 20%** D. 12% Answer:C Explanation: `"Gain%"=("Gain"/"C.P")*100=20%`	
144.	Two trains starting at the same time from 2 stations 200 km apart and going in opposite direction cross each other at a distance of 110 km from one of the stations. What is the ratio of their speeds?		In the same time, they cover 110 km and 90 km respectively. For the same time, speed and distance is inversely proportional. So ratio of their speed = 110:90 = 11: 9	
145.	In 100 m race, A covers the distance in 36 seconds and B in 45 seconds. In this race A beats B by:		**A. 20m** B. 25m C. 22.5m D. 9m Explanation:	

			Distance covered by B in 9 sec. = (100/45)*9m = 20m	
146.	Half percent, written as a decimal, is		A.0.2 B.0.02 **C.0.005** D.0.05 Answer: C Explanation: As we know, 1% = 1/100 Hence, (1/2)% = (1/2 * 1/100) = 1/200 = 0.005	
147.	A pump can fill a tank with water in 2 hours. Because of a leak, it took 2.5 hours to fill the tank. The leak can drain all the water of the tank in:		A. 4 1/3 Hours B. 7 Hours C. 8 Hours **D. 10 Hours** Explanation: Work done by the leak in 1 hour $=\left(\frac{1}{2}-\frac{2}{5}\right)=\frac{1}{10}$. ∴ Leak will empty the tank in 10 hrs.	
148.	If a number is chosen at random from 1 to 100, then the probability that the chosen number is a perfect cube is		We have 1,8,27 and 64 as perfect cubes from 1 to 100. Thus, the probability of picking a perfect cube is 4/100 = 1/25	
149.	Three times the first of three consecutive odd integers is 3 more than twice the third. The third integer is:		A. 9 B. 11 C. 13 **D. 15** Explanation: Let the three integers be x, $x + 2$ and $x + 4$. Then, $3x = 2(x + 4) + 3 \Leftrightarrow x = 11$. ∴ Third integer = $x + 4 = 15$.	
150.	Find the number, when 15 is subtracted from 7 times the number, the result is 10 more than twice of the number		**A. 5** B. 15 C. 7.5 D. 4 Explanation: Let the number be x. 7x -15 = 2x + 10 => 5x = 25 => x = 5	

Faculty Team Prepared **Signatures**

1. **Mr.S.Perumal.**
2. **Mr.M.Soundarrajan.**
3. **Mr.M.Maniyarasan**

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