

Birla Institute of Technology and Science Pilani-KK Birla Goa Campus
FIRST SEMESTER 2022-23

ME F317 Engines, Motors, and Mobility
Comprehensive Examination (Closed Book)

DATE: 20/12/2022

Time: 10 AM - 1 PM

Maximum Marks: 80

Instructions: All symbols used in the question paper have their standard meaning. Question paper has three main questions as Q.I, Q.II, Q.III. Note that Q.I has 40 sub-questions. Q.II and Q.III are present on Page 3. Pages 1&2 of the question paper has to return at 12:45 pm.

Q.I. (ME F317, 20/12/2022). Duration for Q.I is 10:00 am to 12:45 pm.

Q.I. has total 40 sub-questions of objective type as mentioned below. Each below sub-question carries 1 mark and for each wrong answer or writing multiple options (combination of correct and incorrect options) will carry the deduction of 0.5 mark. Improper hand writing wrt option number (i.e creating two options' meaning through single letter [alphabet]) will also be considered as wrong answer. It may be possible that for some or all subquestions may have all or some of their multiple options are correct hence select the correct option number(s) accordingly. **For example:** If Q.44 has option number A and B as a correct options then write your answer as

Q.	Ans.	Q.	Ans.
43.	D	44.	A, B

Name of the student:

ID No.:

Total Correct Answers : × 1 =
Total Wrong Answers : × - 0.5 =
Total non-attempted : × 0.0 = **ZERO**

Net total : ----- = **/ 40**

Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.
1.		6.		11.		16.		21.		26.		31.		36.	
2.		7.		12.		17.		22.		27.		32.		37.	
3.		8.		13.		18.		23.		28.		33.		38.	
4.		9.		14.		19.		24.		29.		34.		39.	
5.		10.		15.		20.		25.		30.		35.		40.	

Q.1. Glow plug is used in (A) DI chambers (B) precombustion chambers (C) swirl chambers (D) air cell chambers.

Q.2. Swirling motion to the air is created in the IDI chambers mainly with the help of shape of (A) minimum swept volume, (B) special chambers, (C) piston, (D) all options (A), (B) and (C).

Q.3. The advantages of the IDI combustion chambers are (A) low injection pressure, (B) direction of spray is not critical, (C) both (A) and (B), (D) good cold starting performance.

Q.4. Injector used for open combustion chambers operates at pressure about (A) 100 bar (B) 200 bar (C) 300 bar (D) 400 bar.

Q.5. To reduce knock in CI engines, engine speed should be (A) high (B) low (C) medium (D) none of these.

Q.6. To increase the knock in SI engines, engine speed should be (A) low (B) high (C) medium (D) none of these.

Q.7. In general, knock in the SI and CI engine occurs respectively in (A) suction and compression strokes (B) expansion and compression strokes (C) expansion and suction strokes (D) all options (A), (B) and (C).

Q.8. In general, optimum angle of injection is about (A) 8° (B) 15° (C) 20° (D) none of these.

Q.9. Increase in intake temperature in CI engine increase(s) (A) density of air (B) volumetric efficiency (C) power output (D) none of these.

- Q.10. To avoid knock, CI engine fuel must have (A) low latent heat of vaporization (B) high latent heat vaporization (C) medium latent heat vaporization.
- Q.11. In case of CI engine, with increase in injection advance, knocking level (A) decreases (B) remains same (C) increases (D) none of these.**
- Q.12. Due to fineness of atomization reduces ignition delay since surface to volume ratio (A) does not change (B) decreases (C) increases (D) none of these.
- Q.13. With decrease in injection advance in CI engine, peak pressure occurs at (A) TDC (B) bTDC (C) aTDC (D) aBDC (E) BDC.**
- Q.14. Physical delay is the period during which the fuel is (A) vaporized (B) vaporized and mixed with air (C) atomized, vaporized and mixed with air (D) none of these.
- Q.15. Longer delay period in CI engine causes pressure rise rate and pressure level respectively as (A) non-rapid and lower (B) non-rapid and higher (C) rapid and higher (D) rapid and lower.**
- Q.16. CI Engine is always designed to operate (A) with rich mixture (B) with stoichiometric air (C) with an excess air (D) none of these.
- Q.17. L-head type combustion chamber has slow combustion process because air flow has to take right angle turn(s) equal to (A) one (B) two (C) three (D) four.**
- Q.18. To have a minimum knocking tendency; spark plug should be located (A) near the cylinder wall (B) in between cylinder wall and the centre of combustion chamber (C) at the centre of combustion chamber (D) none of these.
- Q.19. To avoid the knock in the SI engine, the turbulent level should be (A) low (B) high (C) optimistic (D) none of these.**
- Q.20. Which parameter has strong impact in having knock in the SI engine (A) collision of flames (B) high turbulence (C) preflame formation (D) none of these.
- Q.21. Retarding the spark timing in SI engines gives (A) peak pressure generation during power stroke; (B) low knocking; (C) high knocking; (D) none of these.**
- Q.22. Determine the hot spot(s) in the engine (A) injector, (B) piston, (C) inlet valve, (D) spark plug and cylinder wall, (E) options (A) to (D).
- Q.23. Knocking in SI engine increases with increase in compression ratio because of increase in (A) compression temperature (B) density of the charge (C) Octane number (D) none of these.**
- Q.24. Flame propagation is caused by (A) combustion and diffusion (B) heat transfer and diffusion (D) heat transfer and combustion (d) none of these
- Q.25. A delay period in CI engine effects on (A) combustion rate (B) knocking (C) engine start ability (D) presence of smoke in the exhaust.**
- Q.26. Which statement is not correct with respect to alcohols as alternate fuels in IC engines (A) antiknock characteristics of alcohol is poor (B) their heat energy is half of gasoline (C) does not vaporize as easily as gasoline (D) they are corrosive in nature.
- Q.27. Methanol is not a good for CI engines because its (A) Reynolds number is high (B) Octane number is high and Cetane number is low (C) both Octane number and Cetane number are high (D) none of these.**
- Q.28. Advantage of hydrogen as an IC engine fuel (A) high volumetric efficiency (B) low fuel cost (C) NO HC and CO emissions (D) relatively safe.
- Q.29. Major constituent of natural gas is (A) butane (B) propane (C) ethane (D) methane.**
- Q.30. Octane number of natural gas is around (A) 100 (B) 150 (C) 200 (D) 275.
- Q.31. Chemical formula for Aromatic is (A) C_nH_{2n} (B) C_nH_{2n+2} (C) C_nH_{2n-6} (D) C_nH_{2n-4} .**
- Q.32. Benzene is example of (A) Paraffin (B) Napthene (C) Aromatic (D) Olefin.
- Q.33. Normal Octane has Octane number as (A) 200 (B) 100 (C) 0 (D) none of these.**
- Q.34. To determine the knock, the reference fuels used in CI engines are known as (A) Octane and Cetane (B) Cetane and Heptane (C) Cetane and Alpha methyle naphthalene (D) none of these.
- Q.35. For SI engines, fuels most preferred are (A) Paraffin (B) Napthene (C) Aromatic (D) Olefin.**

Q.36. Valve overlap is the period in which (A) intake and exhaust valves are closed (B) intake valve is open and exhaust valve is closed (C) intake valve closed and exhaust valve is open (D) intake and exhaust valves are open.

Q.37. MEP at a given compression ratio is maximum when the air-fuel ratio is (A) stoichiometric (B) higher than stoichiometric (C) lower than stoichiometric (D) none of these.

Q.38. In SI engines, which factor causes more loss (A) dissociation (B) time (C) exhaust blow down (D) heat.

Q.39. To reduce the loss due to exhaust blow down factor, best range of degrees to open the exhaust valve before BDC is (A) 10-19 (B) 20-39 (C) 40-69 (D) 71 -100.

Q.40. To have a less time loss factor, ignition advance should be around (A) 17° (B) 35° (C) 0° (D) none of these.

Q.II. A single cylinder four stroke hydrogen fuelled SI engine delivers brake power of 20 kW at 6000 rpm. The air gas ratio is 8:1 and calorific value of the fuel is 11000 kJ/m^3 . The compression ratio is 8:1. If volumetric efficiency is 70%, indicated thermal efficiency is 33% and the mechanical efficiency is 90%, calculate the cubic capacity of the engine. **[15]**

Q.III. A petrol engine with compression ratio of 7 used a mixture of iso-octane and hexane as fuel. The pressure and temperature at the beginning of compression process is 1 bar and 55.22°C respectively. If the fuel-air mixture is 19.05% rich and the maximum pressure developed is 115.26 bar then evaluate the composition of the mixture (in percentage weight). Take $C_v = 0.717 \text{ kJ/kgK}$, calorific value of hexane and iso-octane is as 43 MJ/kg and 42 MJ/kg respectively. Take $PV^{1.31}$ is constant for the expansion and compression processes. **[25]**