Ref. No.: Ex/ME(M2)/PC/B/T/313/2024(S)

B.E. MECHANICAL ENGINEERING THIRD YEAR FIRST SEMESTER

SUPPLEMENTARY EXAMINATION-2024

Subject: INTERNAL COMBUSTION ENGINE

Time: 3 hours **Full Marks: 100**

(Answer any FIVE questions)

Q.1	(a)	With a neat sketch, define heat engine.	(3)
	(b)	Compare external combustion and internal combustion engines with examples.	(3)
	(c)	With a neat sketch, explain the working principle of a four-stroke spark-ignition engine.	(8)
	(d)	The cubic capacity of a four-stroke spark-ignition engine is 245cc. The ratio of its stroke to the bore is 0.9. The clearance volume is 27.2 cc. Calculate the bore, stroke and compression ratio of the engine.	(6)
Q.2	(a)	Compare Otto, Diesel and Dual cycles for the same compression ratio and heat rejection on P-v and T-s planes.	(6)
	(b)	In an engine working on Diesel cycle, the inlet pressure and temperature are 1bar and 17°C, respectively. Pressure at the end of adiabatic compression is 35 bar. The ratio of expansion, i.e., after constant pressure heat addition is 5. Plot the cycle on P-v and T-s Planes. Calculate the (i) heat addition and heat rejection per kg of air, and (ii) thermal efficiency and mean effective pressure of the cycle. Assume $\gamma = 1.4$, $C_p = 1.004$ kJ/kg.K and $C_v = 0.717$ kJ/kg.K.	(14)
Q.3	(a)	Mention the assumptions used in fuel-air cycle analysis.	(4)
	(b)	With help of a P-v diagram, explain the losses due to variation of specific heats in an Otto cycle.	(4)
	(c)	What will be the effect on the efficiency of an Otto cycle having a compression ratio of 8, if C_v increases by 1.6%?	(12)
Q.4	(a)	With help of a P-v diagram, briefly explain the (i) time loss factor, (ii) heat loss factor, and (iii) exhaust blowdown factor.	(6)
	(b)	How are the fuels of spark-ignition and compression-ignition engines rated?	(4)
	(c)	With a neat sketch, explain the valve timing diagram of a spark-ignition engine. Clearly state the reasons of opening and closing of the inlet and exhaust valves before/after of the TDC/BDC.	(10)
Q.5	(a)	With a neat sketch, explain the working principle of a simple carburetor.	(8)
	(b)	A simple jet carburetor is required to supply 5kg of air and 0.5 kg of fuel per minute. The fuel specific gravity is 0.75. The air is initially at 1bar and 300K. Calculate the throat diameter of the choke for a flow velocity of 100m/s. Velocity coefficient is 0.8. If the pressure drop across the fuel metering orifice is 0.80 of that of the choke, calculate orifice diameter assuming, $C_{df} = 0.60$ and $\gamma = 1.4$.	(12)
Q.6	(a)	With a neat sketch and labelling each of the essential components, explain working principle of a battery ignition system.	(6)

(b) Briefly explain the stages of combustion in case of S.I. engines, and present each of the stages on the P-θ variation curve. Explain then the detonation phenomenon in case of S.I. engines. (4)

(b) A gasoline engine working on 4-stroke, develops a brake power of 20.9 kW. A Morse Test was conducted on this engine, and the brake power (kW) obtained when each cylinder was made inoperative by short circuiting the spark plug are 14.9, 14.3, 14.8 and 14.5, respectively. The test was conducted at constant speed. Find the indicated power, mechanical efficiency and bmep when all the cylinders are firing. The bore of the engine is 75 mm and the stroke is 90 mm. The engine is running at 3000 rpm. (10)

Q.7 Write short notes on (any four): 5×4

(a) Properties of the lubricants
(b) Pressure feed lubrication system
(c) Common rail injection system
(d) Forced circulation cooling system
(e) Emissions and catalytic converters
(f) Morse test
(g) Crankcase scavenged two stroke S. I. engine
(h) Jerk type fuel pump

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