Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2021

Programme Name: B.Tech. Automotive Design Engg. **Semester : IV th**
Course Name : I. C. Engines **Time : 180 Minutes**
Course Code : MEAD2002 **Max. Marks: 100**
Nos. of page(s) : 4

Instructions: *Read the questions carefully and attempt as per section. Assume suitable data as required and mention in the solution. Support the answers with suitable diagrams as applicable.*

SECTION A

S. No.	Attempt all questions.	**Marks**	**CO**
Q 1	An engine 200 mm bore diameter and 300 mm stroke works on otto cycle. The clearance volume is 0.0016 m^3. The initial pressure and temperature are 1 bar and 300 K respectively. The heat transfer to air per cycle is 1900 kJ/kg of air. Calculate : (i) Thermal efficiency (ii) Mean effective pressure	**5**	**CO1**
Q 2	Explain the combustion chamber design principles of SI engines related to ensure the smooth operation (No Knocking).	**5**	**CO3**
Q 3	A two-stroke cycle internal combustion engine has a mean effective pressure of 6 bar. The speed of the engine is 1000 rpm. If the diameter of piston and stroke are 110 mm and 140 mm respectively, find the indicated power developed.	**5**	**CO2**
Q 4	Explain the requirements of fuel injection system in CI engine.	**5**	**CO2**
Q 5	Explain the A/F Mixture requirement of SI Engine in following cases: (i) Cruising or normal power (ii) Acceleration	**5**	**CO3**
Q 6	Discuss in brief the effect of A/F ratio in SI emission: NOx, CO and unburnt hydrocarbon.	**5**	**CO5**

SECTION B (50 Marks)

	Attempt five questions. There is internal choice is in Q. No. 3 and 4.		
Q 1	Explain the applicable knocking theories to explain the abnormal combustion in SI Engines. Suggest any two parameters to reduce the knocking. Support with suitable diagrams.	**10**	**CO3**
Q 2	(a)Explain the stages of combustion in CI engines with help of Heat release rate diagram after imposing with injection characteristics. (b) Explain the ignition delay in detail.	**8+2**	**CO3**

Q 3	Compression ratio in an air standard Otto cycle is 9. At the beginning of compression process the pressure and temperature are 1 bar and 300 K respectively. The heat transfer to air per cycle is 1800 kJ/kg of air. Calculate: (i) Thermal efficiency (ii) The mean effective pressure OR An oil engine works on the ideal diesel cycle. The overall compression ratio is ***18:1*** and the heat is added at constant pressure in 10% of stroke volume (V_3-V_2= 10% V_s). Intake conditions are 1 bar and 20^0 C . The engine uses 100m^3 of air per hour. Use standard properties of air ϒ=1.4, Cp= 1.005 kJ/kg, Cv = 0.714 kJ/kg etc. Determine; (a) Max temperature/ pressure of cycle, (b) thermal efficiency of engine & indicated power of the engine and	**10**	**CO1/ CO2**
Q 4	Explain the evaporative losses in SI engines. Explain the technology to be adopted to reduce the evaporative losses with help of suitable diagram. **OR** Discuss the genesis of HC sources in SI engine with help of flow chart.	**10**	**CO5**
Q 5	A six cylinder 4 stroke CI engine develops 220 kW at 1500 rpm with brake specific fuel consumption of 0.273 kg/kWh. Determine the size of single hole injector nozzle if the injection pressure is 160 bar and combustion pressure in cylinder is 4o bar. The injection duration is $30^0$of crank angle. Specific gravity of fuel may be considered as 0.85 and coefficient of orifice discharge is 0.9. **OR** Design the main dimensions of a carburetor for the following data of a four stroke, four cylinder engines. Bore = 80 cm, Stroke = 100 cm, Speed = 2800 rpm Volumetric efficiency = 90%, Venturi depression = 0.10 bar A/F = 13:1, Density of air = 1.16 kg/m^3, specific gravity of fuel =0.78 Neglect the compressibility.	**10**	**CO3/ CO4**
SECTION-C (20 Marks)			

Q 1	During the trial of a single acting oil engine for duration of 60 minutes, following observation were made: Engine Type : 2 Stroke engine Cylinder bore= 200 mm Length of stroke = 280 mm Indicated mean effective pressure= 2.74 bar Engine speed = 350 rpm Fuel oil used per hour = 4.22 kg Calorific value of oil = 44670 kJ/kg Brake torque = 600 Nm Mass of jacket cooling water = 135 kg Temperature of exhaust gases = 370 ^{0} C Temperature of air in test room = 20 ^{0} C Inlet temperature of cooling water = 13 ^{0} C Outlet temperature of cooling water = 38 ^{0} C Mean specific heat of exhaust gases = 1.005 kJ/kg K Hydrogen in fuel (on Mass basis) = 15% Specific heat of steam in Exhaust gases = 2.093 kJ/kgK Assume pressure of steam in exhaust gases = 1.01325 bar Calculate; (a) Mechanical & Indicated thermal efficiency (b) Brake specific fuel consumption (c) Draw up the heat balance sheet in kJ/min and percentages of heat supplied to engine Consider properties of steam from following table:	**20**	**CO4**

p (bar)	t_s (^oC)	v_f (m^3/kg)	v_g (m^3/kg)	u_f (kJ/kg)	u_g (kJ/kg)	h_f (kJ/kg)	h_g (kJ/kg)	s_f (kJ/kg K)	s_g (kJ/kg K)
1.01325	100.0	0.001044	1.673	419	2507	419	2676	1.307	7.355

OR

Following readings were taken during a test on single cylinder 4 –stroke oil engine ;

Cylinder bore	***250mm***
Stroke length	***400 mm***
Indicated mean effective pressure	***6.8bar***
Engine speed	***300 rpm***
Fuel oil used per hour	***3.4kg***
Calorific value of fuel	***42000kJ/kg***
Brake torque	***480Nm***
Mass of jacket cooling water per minute	***5.1kg***
Rise in temperature of jacket cooling water	40^0C
Mass of air supplied per minute	***1.35kg***
Temperature of exhaust gases	350^0C
Room temperature	20^0 ***C***
Mean specific heat of dry exhaust gases	***1.1 kJ/kg***
Hydrogen in fuel on mass basis	***12.5 %***
Specific heat of steam in exhaust gases	***2.1 kJ/kgK***
Pressure of steam in exhaust gases	***1.01325 bar***
Specific heat of water	***4.18 kJ/kgK***

Calculate the mechanical and indicated thermal efficiencies and brake specific fuel consumption. Also draw up the heat balance sheet in kJ/min and as percentage of heat supplied to engine with help of pie chart/ Sanky's diagram. Analyse the heat balance and make your conclusions.