**Enrolment No**

# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

## End Semester Examination, May 2019

**Programme Name: B.Tech. Mechanical & Mechanical (Spl in Thermal/Machine Design/Production/ MSNT )**
**Semester : VI**
**Course Name : I. C. Engines**
**Time : 03 Hrs** **Max. Marks: 100**
**Course Code : MHEG 353**
**Nos. of page(s) : 3**
**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 (20)**

**Attempt all questions. Support answer with suitable diagrams if any.**

| S. No. | Statement of Problem | Marks | CO |
|---|---|---|---|
| Q 1 | Explain knocking in SI engines with help of auto ignition theory. Also mention the adverse effect of knocking on engine operation. | **5** | **CO1** |
| Q 2 | Discuss the effect of following engine variables on flame propagation :<br>(i) Air fuel ratio<br>(ii) Compression ratio<br>(iii) Engine load | **5** | **CO1** |
| Q 3 | Discuss the general design principles of SI Engines combustion chamber design by considering the following requirement:<br>(i) Higher power Output<br>(ii) Low knocking | **5** | **CO3** |
| Q 4 | Explain the working of EFI system used in gasoline engines with help of suitable diagram. | **5** | **CO 3** |
| | **SECTION B (40)**<br>**Attempt all questions. There is internal choice in Q. No. 8** | | |
| Q 5 | Explain the Genesis of Unburnt hydrocarbon (UNBHC) emission in SI engines with help of suitable flow diagram. Suggest the any one control technology with principle of operation and suitable sketch to be incorporated to reduce the UNBHC. | **10** | **CO3** |
| Q.6 | The initial condition of air in an Otto cycle is 288K and 1.05 bar. The air is compressed isentropic ally to pressure of 13 bar. Then the heat is added at constant volume till the pressure becomes 35 bar. Calculate; | **10** | **CO1** |

| | | | |
|---|---|---|---|
| | (a) Compression ratio<br>(a) Air standard efficiency and<br>(b) Mean effective pressure of cycle. | | |
| Q 7 | (i) Compare the knocking in SI & CI Engines with help of p-θ diagram.<br>(ii) Compression ratio in compression Ignition Engines cannot be increased to very high value. Justify the statement with the reasons. | **06**<br>**04** | **CO3**<br>**CO3** |
| Q 8 | A single jet carburetor is to supply 6 kg/min of air and 0.4 kg/min of petrol of specific gravity 0.75. The air initially at 1.013 bar and $27^0$ C. Assuming an isentropic coefficient of 1.4 for air, determine;<br>(i) The diameter of venturi if air speed is 90 m/s and velocity coefficient for venturi is 0.85<br>(ii) The diameter of jet if pressure drop at the jet is 0.8 times the pressure drop at venturi and the discharge coefficient for fuel jet is 0.66.<br>**OR**<br>The four stroke petrol engine of Hindustan Ambassador has a capacity of 1489 $cm^3$. It develops maximum power at 4200 rpm. The volumetric efficiency at this speed is 70% and air/fuel ratio is 13:1.<br>At peak power the theoretical air speed at throat is 90 m/s. The coefficient of discharge for venturi is 0.85 and that of main petrol jet is 0.66. The petrol surface is 6 mm below the throat at this engine condition. Calculate the sizes of throat and main jet. The specific gravity of petrol is 0.75. Atmospheric pressure and temperature are 1.013 bar and $27^0$ C. | **10**<br>**10** | **CO2** |
| **SECTION-C (40)**<br>**Attempt all questions. There is internal choice in Q. No. 10(i) .** | | | |
| Q 9 | (i) Explain typical Heat release rate model used to explain the stages of combustion in direct injection compression ignition engine.<br>(ii) Explain the ignition delay with reference to CI engines. Explain the 6 important variables affecting the ignition delay with help of suitable diagrams if any. | **10**<br>**10** | **CO1/CO2** |
| Q 10 | (i) Following readings were taken during a test on single cylinder 4 –stroke oil engine ; | **14** | **CO4** |

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|---|---|
| Cylinder bore | 20 cm |
| Stroke length | 35 cm |
| Indicated mean effective pressure | 7 bar |
| Engine speed | 240 rpm |

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|---|---|---|---|---|
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|---|---|
| Fuel oil used per hour | 3.5 kg |
| Calorific value of fuel | 46000 kJ/kg |
| Brake torque | 450 Nm |
| Mass of jacket cooling water per minute | 5 kg |
| Rise in temperature of jacket cooling water | $40^0$C |
| Mass of air supplied per minute | 1.35 kg |
| Temperature of exhaust gases | $340^0$C |
| Room temperature | $15^0$C |
| Mean specific heat of dry exhaust gases | 1 kJ/kg |
| Hydrogen in fuel on mass basis | 13.5 % |
| Specific heat of steam in exhaust gases | 2.3 kJ/kgK |
| Pressure of steam in exhaust gases | 1.01325 bar |

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 Sanky's diagram. Analyse the heat balance and make your conclusions.

**OR**

(i) During the trial of a single cylinder, four stroke oil engine, the following results were obtained — **14** — **CO4**

Cylinder diameter: 20 cm;

Stroke: 40 cm;
Indicated Mean effective pressure: 6 bar;
Torque: 407 Nm;
Speed: 250 rpm;
Oil consumption: 4 kg/h;
Calorific value of fuel: 43 MJ/kg;
Cooling water flow rate: 4.5 kg/min;
Air used per kg of fuel: 30 kg;
Rise in cooling water temperature: 45 deg C;
Temperature of exhaust gases: 420 deg C;
Room temperature: 20 deg C;
Mean specific heat of exhaust gas: 1 kJ/kg K;
Specific heat of water: 4.18 kJ/kg K.

Find the BP, IP and Also draw up the heat balance sheet in kJ/h and as percentage of heat supplied to engine with help of Sanky's diagram. Analyse the heat balance and make your conclusions.

(ii) Determine the diameter of fuel orifice for a 4-stroke engine developing 15 kW per cylinder at 2000 rpm consuming 0.272 kg/kW-hr fuel of specific gravity 0.865. The duration of injection is $30^0$ crank travel. The fuel injection pressure is 120 bar and combustion chamber pressure is 30 bar. Take velocity — **6** — **CO2**

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|---|---|---|---|
| | coefficient 0.9. | | |