University of Mumbai
Examinations Summer 2022

Subject: Thermal Engineering **Sem:V**
Time: 2 hour 30 minutes Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	Thermal conductivity of pure metals
Option A:	Decreases with increase in temperature
Option B:	Increases with increase in temperature
Option C:	Does not have any effect of temperature
Option D:	Depending on range of temperature
2.	In a diesel engine, the fuel is ignited by
Option A:	spark
Option B:	injected fuel
Option C:	heat resulting from compressing air that is supplied for combustion
Option D:	Ignition
3.	The volumetric efficiency of a well-designed engine is in the range
Option A:	30 to 40%
Option B:	40 to 60%
Option C:	60 to 70%
Option D:	75 to 90%
4.	Which statement is true regarding steady state condition?
Option A:	There is a variation in temperature in the course of time
Option B:	Heat exchange is constant
Option C:	It is a function of space and time coordinates
Option D:	Internal energy of the system changes
5.	The air standard efficiency of an Otto cycle compared to diesel cycle for the given compression ratio is
Option A:	same
Option B:	less
Option C:	more
Option D:	more or less depending on power rating
6.	If the intake air temperature of I.C. engine increases, its efficiency will
Option A:	increase
Option B:	decrease
Option C:	remain same
Option D:	unpredictable
7.	**Absorptive power of perfectly black body is**
Option A:	zero
Option B:	one
Option C:	infinity
Option D:	constant
8.	**Opaque body is**
Option A:	Absorbs all radiation
Option B:	Reflects all radiation
Option C:	Transmit all radiation
Option D:	Some reflect and some absorbs

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9.	**The phenomenon of heat transfer is deals with**
Option A:	Temperature transfer
Option B:	Work transfer
Option C:	Energy transfer
Option D:	Mass transfer
10.	**With increase in temperature the thermal conductivity of air**
Option A:	Increases
Option B:	Decreases
Option C:	Remain constant
Option D:	May increase or decrease depending on the temperature

Q2	**Solve any Four Questions out of Six** **5 marks each**
A	Derive an expression for one dimensional steady state heat conduction through plane wall.
B	Discuss the concept and application of steady and unsteady state heat transfer along with the practical example of each.
C	Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500 °C. 1. Monochromatic emissive power at 1.2 µm 2. Wave length at which the emission is maximum Total emissive power of the furnace if it is assumed as real surface with emissivity equal to 0.8
D	Discuss in detail about the effect of engine variables on detonation in Spark ignition engines
E	A cylinder rod of 1 cm diameter and 1 m long is initially mainlined at 300 °C. It is suddenly dropped in oil at 50 °C having convective heat transfer coefficient at 240 W/m^{2}K. Find the time required to cool the rod up to 120 °C. Properties of rod material is as follows: Density = 8000 kg/m^3. C=400 J/kg/K. k= 60 W/mK
F	The following details were noted in a test on a four-cylinder, four-stroke engine, diameter = 100 mm; stroke = 120 mm; speed of the engine = 1600 rpm; fuel consumption = 0.2 kg/min; calorific value of fuel is 44000 kJ/kg; difference in tension on either side of the brake pulley = 40 kg; brake circumference is 300 cm. If the mechanical efficiency is 80%, calculate (i) brake thermal efficiency (ii) indicated thermal efficiency (iii) indicated mean effective pressure and (iv) brake specific fuel consumption

Q3	**Solve any Two Questions out of Three** **10 marks each**
A	Derive an expression for temperature distribution and heat dissipation in a straight fin of rectangular profile for insulated tip.
B	An aluminum rod 2 cm diameter and 10 cm long protrudes from the wall maintained at 300 °C. The rod is exposed to surroundings at 15°C. Heat transfer coefficient between rod surfaces an environment is 20 W/m^{2}K. The thermal conductivity of the material is 200 W/mK. Find 1. Total heat dissipated by rod 2. Temperature of road at 4 cm from the wall 3. Temperature at the end of rod 4. Fin efficiency Assume that the rod end is insulated
C	A four stroke gas engine has a cylinder diameter of 25 cm and stroke 45cm. The effective diameter of the brake is 1.6m. The observations made in the test of the engine were as follows. Duration of the test 40 minute, total number of revolutions = 8080. Total no of explosions = 3230, net load on the brake = 90 kg, mean effective pressure = 5.8 bar, volume of gas used = 7.5 m^3, pressure of gas indicated in meter = 136 mm of water of gauge, atmospheric temperature = 17 °C, calorific value of the gas 19 MJ/m^3 at NTP. Rise in temperature of the jacket cooling water = 45 °C , Cooling Water Supplied 180 Kg. Draw up the heat balance

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	sheet and estimate the indicated thermal efficiency and brake thermal efficiency. Assume atmospheric pressure as 760 mm of Hg

Q4	**Solve any Four Questions out of Six** **5 marks each**
A	Draw a neat boiling curve for water and show the different boiling regimes. Explain the phenomenon of condensation
B	Derive an expression for log mean temperature difference in parallel flow heat exchanger. State your assumption.
C	Water(mass flow rate of 1.4 kg/s, Cp= 4.187 kJ/kgK) is heated from 40 °C to 70 °C by an oil (mass flow rate 2kg/s, Cp 1.9 kJ/kgK) entering at 110 °C in a counter flow heat exchanger. If overall heat transfer coefficient is 350W/m^2K, Calculate the surface area required
D	What are the different control methods for engine emissions
E	What is the governing law of diffusion mass transfer?
F	Discuss about valve timing diagram for four stroke petrol engine.

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