DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE
End Semester Examination *(Regular)* – December 2019

Branch: B.Tech in Mechanical Engineering **Sem:** V
Subject Name with Code: Heat Transfer [BTMEC 501] **Date:** 09/12/2019
Max Marks: 60 **Duration:** 3 hr.

Instructions to the Students:

1. *Solve **ANY FIVE** questions out of the following six questions.*
2. *Each question carries 12 marks.*
3. *The level question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in ( ) in front of each question.*
4. *Use of non-programmable scientific calculator is allowed.*
5. *Assume suitable data wherever necessary and mention it clearly.*

		(Level/CO)	Mar
Q. 1	**Solve the following:**		
A)	Define overall heat transfer coefficient. How is it related to thermal resistance? Write down equation for total thermal resistance for composite hollow cylinder made up of two layers (*with thermal conductivity k_1, k_2 with thickness b_1, b_2*) and convective boundary conditions on either sides of composite cylinder with convective heat transfer coefficients h_1, h_2. Assume some notation for radii like r_1, r_2, r_3.	(CO-2)	6
B)	A composite wall of $1m^2$ surface area is constructed of two layers. The first layer is of 1 cm thick steel (k = 45 W/m K) and the second layer of 10 cm thick fiberglass insulation (k = 0.035 W/m K). Determine: a) thermal resistance of the composite wall b) overall heat transfer coefficient.	(CO-1)	6
Q.2	**Solve the following:**		
A)	Derive equation for critical radius of insulation for a cylinder. A 2 mm diameter electric wire at 46°C is covered by 0.5 mm thick plastic insulation (k = 0.03 W/m K). The insulation of the wire is exposed a medium at 10°C with convective heat transfer coefficient of 20.0 W/m^2 K. Determine the critical insulation thickness. Will plastic insulation dissipate max heat?	(CO-2)	6
B)	Write equations for Biot number & Fourier number. Aluminium sphere weighing 5.5 kg and initially at a temperature of 290°C is suddenly immersed in a fluid at 15°C. The convective heat transfer coefficient is 58 W/m^2K. Estimate the time required to cool the aluminium to 95°C. Use lumped capacity method for calculation. Assume following property values for aluminium: $\rho = 2700$ kg/m^3 k = 205 W/m K $C_p = 900$ J/kg K	(CO-2)	6
Q. 3	**Solve the following:**		
A)	Sketch laminar and turbulent boundary layers (BL) for flow over a flat plate. Also, show velocity profiles within the BL in the two regions: a) in the laminar region b) in the	(CO-4)	6

turbulent region. Assume uniform velocity profile on the upstream side of the plate. State the value of Re at transition.

B) Air at 60°C and atmospheric pressure flows over a thin flat plate (*one side)* which is 1 m wide and 2 m in length. The free stream air velocity is 1 m/s. Calculate **a)** thickness of velocity boundary layer at a distance x = 1.5 m and **b)** total drag force on the plate. (CO-4) **6**

Use following values of fluid properties:

$\upsilon = 18.96 \times 10^{-6}$ m²/s, $\rho = 1.06$ kg/m³

Use following equations for thickness of velocity boundary layer and drag coefficient, respectively:

$$\frac{\delta}{x} = \frac{5}{\sqrt{Re_x}} \quad and \quad C_f = 1.328\, Re_L^{-0.5}$$

Q.4 Solve the following:

A) Water at 50°C enters 1.5 cm diameter tube of a heat exchanger. Assume velocity of water at mean temperature as 1 m/s. The tube surface is maintained at 90°C. (CO-4) **6**

Calculate the exit water temperature if the length of tube is 2 m

Assume following properties of water at mean temperature *(neglect variation in properties with temperature):*

$\mu = 489.2 \times 10^{-6}$ kg/(m.s)
$\rho = 984.4$ kg/m³
k = 0.656 W/m K
$c_p = 4178$ J/kg K

Use following correlations:

$$f = 0.079\, Re^{-0.25}$$

$$Nu_D = \frac{(f/2)[Re_D - 1000].Pr}{1 + 12.7\left[f/2\right]^{0.5}(Pr^{2/3} - 1)}$$

B) A 15 cm diameter horizontal iron pipe with 1 m length is exposed to saturated steam at 100°C on inside and still air at 20°C on outside. Calculate the convective heat transfer rate from the outer surface of pipe and compare it with radiant heat transfer rate if the surrounding surfaces (imaginary) are at 20°C. Assume outer surface of the pipe as black. (CO-4) **6**

Use following correlation for horizontal pipe:

$$Nu = 0.48\, Ra^{0.25}$$

Use following values of properties of air at 60°C:

$\rho = 1.06$ kg/m³ $\mu = 20.1 \times 10^{-6}$ N.s/m², k = 0.029 W/m K $C_p =$ 1005 J/kg K

Q. 5 Solve the following:

A) In a double-pipe counter-flow heat exchanger 10,000 kg/h of an oil having a specific heat 2095 J/kg.K is cooled from 80°C to 50°C by 8000 kg/h of cooling water at 25°C. Assume overall heat transfer coefficient of 300 W/m²K and specific heat of water as 4180 J/kg.K. (CO-5) **6**

a) Determine LMTD
b) Determine the heat exchanger area.

B) Draw the pool boiling curve & identify different boiling regimes. Define critical flux & show corresponding point on pool boiling curve. **6**

Q. 6 Solve the following:

A) Consider a 20 cm diameter spherical ball at 800 K suspended in air. Assuming the ball closely approximates a blackbody, determine: (CO-6) **6**

a) The total blackbody emissive power
b) The amount of radiant energy emitted by the ball in 5 min.
c) The monochromatic blackbody emissive power at a wavelength of 3 micrometers.

B) State various shape factor relations (algebra) in radiation heat transfer. (CO-6) **6**

***** End *****

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DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,
LONERE – RAIGAD -402 103
Semester Winter Examination – Dec. - 2019

Branch: Mechanical Engineering. **Sem.:- V**
Subject: - Applied Thermodynamics – I (BTMEC502) **Marks: 60**
Date:- 11/12/2019 **Time:- 3 Hr.**

Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

Q.1 a) What is meant by term fuel? Classify fuels in detail. ---------- (6)
b) Explain briefly, the method used to determine the higher calorific value of the liquid. -------- (6)

Q 2 a) Describe with neat diagram, the construction and working of a Babcock and Wilcox water tube boiler. ---------- (6)

b)The following observations were made in a boiler trial:
Coal used 250kg of calorific value 29800kJ/kg, water evaporated 2000kg, steam pressure 11.5 bar, dryness fraction of steam 0.95 and feed water temperature 34^{0}C Calculate the equivalent evaporation "from and at 100^{0}C" per kg of coal and the efficiency of the boiler. ---------- (6)

Q.3 a) With pv and Ts diagram explain Carnot vapour cycle in detail. ---------- (6)
b) Show the Rankine cycle on p-v and T-s diagrams and explain the processes involved. ---------- (6)

Q4 a) Dry saturated steam at a pressure of 15 bar enters in a nozzle and is discharged at a pressure – of 1.5 bar. Find the final velocity of steam, when the initial velocity of steam is neglible. If 10% of the heat drop is lost in friction, find the percentage reduction in the final velocity. --- (6)
b) With h-s graph explain effect of friction between nozzle surface and steam. - (6)

Q.5 a) In a De- lavel turbine , the steam enters the wheel through a nozzle with a velocity of 500 m/s and at an angle of 20^0 to the direction of motion of blade. The blade speed is 200m/s and the exit angle of moving blade is 25^0. Find the inlet angle of moving blade, exit velocity of steam, and its direction and work done per kg of steam. ---------- (6)
b) What do you mean by compounding of the turbine. Draw the neat sketch of the 3 stage velocity compounding with variation of pressure, velocity and specific volume. (6)

Q.6 a) With neat sketch and cycle representation explain the working of the centrifugal compressor. (6)

b) With neat sketches explain construction, working of Reciprocating air compressor with applications. (6)

Paper End

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Winter Semester Examination – December - 2019

Branch:- Mechanical **Sem.:- V**

Subject with Subject Code:- Machine Design –I(BTMEC503) **Marks:60**

Date:- 13/12/2019 **Time:- 3 Hr.**

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Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

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(Marks)

Q.1. Any two

a) Define Machine Design. Explain various design considerations **(6)**

b) Explain Aesthetic consideration in design with sketches. **(6)**

c) Explain ergonomics consideration in design of control & display. **(6)**

Q.2. Any Two

a)The load on a bolt consists of an axial load of 10 KN together with transverse shear force of 5 KN. Find the diameter of bolt required according to maximum shear stress theory. The permissible tensile stress at elastic limit =100MPa, and F.S.=1 **(6)**

b)Cotter joint to support a load of 30 KN. The material used is plain carbon steel with stresses, Tensile stress = 50 MPa, Shear stress = 35 MPa, Crushing stress = 100 MPa Find **1)**Diameter of rod ,d **2)**Diameter of spigot end,d2 **3)**Width of cotter,b **4)**Thickness of cotter,t **5)**Diameter of socket **(6)**

c) Write design process of knuckle joint with suitable sketches **(6)**

Q.3. Any two

a) What is stress concentration? What are the causes of stress concentration & remedies for stress concentration. **(6)**

b)Define(any three)

1)Fatigue failure, **2)**Endurance limit, **3)**Notch sensitivity , **4)**Reversed stress **5)**Repeated stress **(6)**

c)A steel rod subjected to reversed axial load of 180 KN.Find the dia. of the rod if F.S.= 2, Ultimate strength = 1070MPa, Yield strength=910MPa, Endurance strength = half of ultimate strength, Ka=0.8, Kb=0.85, Kc=0.7, Kf=1. **(6)**

Q.4. Any two

a) Find the diameter of solid steel shaft to transmit 20KW at 200 rpm. The safe shear stress = 45MPa. If hollow shaft is to be used in place of solid shaft, find the inside & outside diameter when ratio of inside to outside diameter is 0.5 **(6)**

b) Prove that crushing stress is twice the shear stress when key is equally strong in crushing & shearing and also give sketches. **(6)**

c) Design muff coupling to transmit 40KW at 350 rpm. For shaft & key, Shear stress=40MPa, Crushing stress=80MPa, For muff-Shear stress=15MPa. **(6)**

Q.5. Any two

a) A vertical two start square threaded screw of 100mm mean diameter and 20 mm pitch supports a vertical load of 18 KN. The axial thrust on the screw is taken by collar bearing of 250 mm outside diameter and 100 mm inside diameter. Find the force required at the end of lever which is 400mm long in order to lift or to lower the load μ=0.15& μ1=0-20. **(6)**

b)A plate 100mm wide and 10 mm thick is to be welded to another plate by means of double parallel fillet weld. The plates are subjected to static load of 80 KN. Find the length of weld if shear stress = 55MPa. **(6)**

c) Explain with sketch bolt of uniform strength. **(6)**

Q.6.

a)Define the terms related to springs

1)Solid length **2)**Free length

3)Spring index **4)**Spring rate . **(6)**

b) Design a helical compression spring for a maximum load of 1000N for a deflection of 25 mm. Using spring index =5,Shear stress = 420MPa, Modulus of rigidity = 84000 MPa, consider effect of stress concentration. **(6)**

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,
LONERE – RAIGAD -402 103
Winter Semester Examination – December - 2019

Branch: B. Tech Mechanical **Sem.:- V**
Subject with Code: - Theory of Machine -II (BTMEC504) **Marks: 60**
Date:- 16/12/2019 **Time:- 3 Hr.**

Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately Assume it and should mention it clearly

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(Marks)

Que.1. **(2×6=12)**

A) A pulley is driven by a flat belt, angle of lap being 120^0. The belt is 100 mm wide by 6 mm thick and density 1000 kg/m^3. If coefficient of friction is 0.3 & maximum stress in belt is not exceed 2 MPa. Find greatest power which the belt can transmit & corresponding speed of belt.

B) Explain centrifugal Tension in belt.

Que.2. **(2×6=12)**

A) What do you understand by the term 'Interference' & 'undercutting' as applied to gears

B) A pinion of 20 involutes teeth and 125mm pitch circle diameter drives a rack. The addendum of both pinion and rack is 6.25mm. What is the least pressure angle which can be used to avoid interference? With this pressure angle, find the length of the arc of contact and the minimum numbers of teeth in contact at a time.

Que.3. Attempt the following

A) Explain compound gear train with neat sketch. (6)

B) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B. (6)

Que. 4. **(2×6=12)**

A) The turning moment diagram for a petrol engine is drawn to the following scales : Turning moment, 1 mm = 5 N-m Crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 295, 685, 40, 340, 960, 270 mm^2 . The rotating parts are equivalent to a mass of 36kg at a radius of gyration of 150mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 r.p.m.

B) Explain the terms. i) Sensitiveness of governor. ii) Stability of governor.

iii) Isochronism. iv) Hunting of governor.

Que. 5. **(2×6=12)**

A) The mass of the turbine rotor of a ship is 20 tonnes and has a radius of gyration of 0.6m Its speed is 2000 r.p.m. The ship pitches 6° above and 6° below the horizontal position. The complete oscillation takes 30 seconds and the motion is simple harmonic. Determine the following. i) Maximum gyroscopic couple. ii) Maximum angular acceleration of the ship during pitching and iii) The direction in which the bow will tend to turn when rising, if the rotation of the rotor is clockwise when looking from the left.

B) The turbine rotor of ship has a mass of 2000kg and rotates at a speed of 3000r.p.m. clockwise when looking from a stern. The radius of gyration of the rotor is 0.5m. Determine the gyroscopic couple and its effect upon the ship when the ship is steering to the right in curve of 100m radius at a speed of 16.1 knots (1 knot = 1855 m/h) calculate also the torque and its effects when the ship is pitching in simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 50 seconds and the total angular displacement between the two extreme positions of pitching is 12°. Find the maximum acceleration during pitching motion.

Que. 6. Solve the following.

A) Explain Rayleigh's method. **(6)**

B) Explain and derive expression for critical or whirling speed of a shaft. **(6)**

*******End Paper*******

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Winter Semester Examination – December - 2019

Branch:- Mechanical **Sem.:- V**
Subject:- :- Metrology and Quality Control (BTMEC505) **Marks: 60**
Date:- 18/12/2019 **Time:- 3 Hr.**

Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

			(Marks)
Q.1.	a)	Explain the phenomenon involved in 'wringing' of slip gauges.	(06)
	b)	Comparison between Systematic Errors and Random Errors.	(06)
Q.2.	a)	Define fit and with the help of neat sketches, explain in short the different types of fits.	(06)
	b)	Explain the working principle of a laser interferometer with the help of neat sketches.	(06)
Q.3.	a)	What is the radial runout of a gear? How is it measured?	(06)
	b)	With the help of a sketch, discuss screw thread terminologies.	(06)
Q.4.	a)	What is Quality Statements	(06)
	b)	Briefly discuss on 'Seven Quality Tools'.	(06)
Q.5.	a)	State the significance of 'Zero defects'	(06)
	b)	Describe a Quality function deployment.	(06)
Q.6.	a)	Write a note on 'JIT'	(06)
	b)	Write a short note on ISO 9000 standards?	(06)

Paper End