QP code : 10097407

TE sem VI Mechanical R-19 cscheme

[03 Hours] [Total marks – 80]

N.B.: 1. Question No **1** is **compulsory**
2. Solve **Any Three** questions from the remaining **Five** questions.
3. Assume any **suitable data** if necessary with justification.
4. Use of **Standard Data Book** is permitted
5. Figures to the right indicate full marks.

Q1. Attempt any **Four** of the following. **20**

(a) State the characteristics of chain drive and discuss the polygon effect. **05**

(b) List out the design considerations in casting & Forging **05**

(c) Explain the nipping of the leaf spring with neat sketch **05**

(d) Explain self-locking and Overhauling Screws? **05**

(e) Define stress concentration and with neat sketches explain various methods to reduce the effect of stress concentration. **05**

Q2. **(a)** Design a Socket and Spigot Cotter Joint for an axial load of 20 KN by selecting suitable material. Check Cotter for bending and draw the neat sketch of joint. **15**

(b) Why and what value of taper is provided on Cotter? **05**

Q3. **(a)** The shaft is supported in bearings 800 mm apart and transmits 10 KW at 960 R.P.M. through a pulley 'C' of 300 mm diameter which is mounted at 350 mm to the right of left hand bearing. The angle of lap is 180° and coefficient of friction between the belt & the pulley is 0.3. Select suitable material and design the shaft. Take belt tensions at pulley 'C' as vertically downward. The pulley 'C' weighs 400 N. Sketch the arrangement. **15**

(b) The piston rod of a hydraulic cylinder exerts an operating force of 10 KN. The friction due to piston packing and stuffing box is equivalent to 10% of operating forces. The pressure in cylinder is 10 MPa. The cylinder is made of C.I. with σt =50 MPa. Determine thickness of cylinder using Lame's equation. **05**

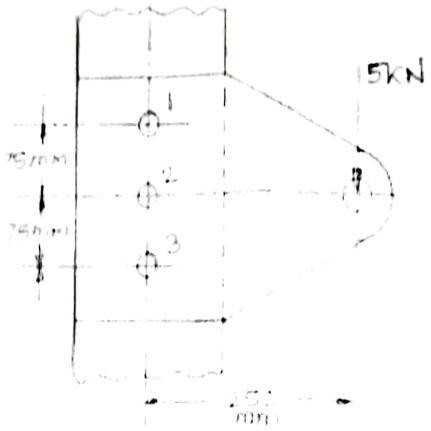
Q4. **(a)** DGBB is subjected to a radial load of 6 KN and axial load of 2 KN when operating on 500 rpm. Consider the expected life of 20000 hours with survival probability of 92%. Select suitable standard bearing from the manufacturer's catalogue. **10**

(b) A radial load on 360° hydro dynamically lubricated self-contained bearing supports 10kN. The journal rotates at 1440 rpm. Assuming journal length to it diameter as 1 with the bearing length as 50 mm. Take radial clearance as 20 microns, eccentricity as 20 microns, specific gravity of lubricants as 0.86, specific heat of lubricants 2.09 kJ/kg °C. Find, **10**

i. Oil film thickness.
ii. Coefficient of friction.
iii. Viscosity

Q5. **(a)** A protected type flange coupling is required to transmit 12 KW at 960 r.p.m. Design the coupling by selecting suitable materials for various component. **10**

(b) A steel plate is subjected to a force of 5 KN and fixed to a channel by means of 3 identical bolts as shown in fig. no.1. Determine the size of weld if the permissible shear stress for the weld is not to exceed 50 MPa. **10**



(Fig. No.1)

Q6. **(a)** 75 kW power is transmitted by multi-plate clutch at 3000 rpm. The plates run in oil and coefficient of friction is 0.07. Axial intensity of pressure is not to exceed 0.15 N/mm^2. Due to space limitation external radius is restricted to 125 mm. Assuming number of springs as 6. **10**

i. Design input and output shaft. ii. Design friction and pressure plates.

(b) A flat belt drive is used to transmit 6 kW power from an electric motor rotating at 1440 rpm to the blower operating at 400 rpm for 10 hours/ day and the expected life of belt is two and half years approximately. Centre to centre distance is 950 mm. Find **10**

a. Driving and Driven pulley diameter.
b. Considering Rubber Canvas Material for the belt, determine the thickness and width of the belt.

****

TE - sem-VI - mech - R-19

QP : 20000218

Duration: 3 Hrs

[Max Marks:80]

N.B.: 1. Question No.1 is compulsory
2. Attempt any three questions from the remaining questions.
3. All questions carry equal marks.
4. Assume suitable data if necessary and state it clearly.
5. Use of Refrigerant tables, Friction Charts, Psychrometric Charts, and Steam Tables are permitted.

1. **Answer ANY FOUR from the following.** [20]

a. Define human comfort. Explain the factors affecting human comfort.

b. Define the term 'effective temperature' and explain its significance in the design of air conditioning systems.

c. Define: i) Ton of Refrigeration ii) Bypass Factor iii) Dry bulb temperature iv) Wet bulb temperature v) Humidity ratio

d. Explain the working of a simple air cycle cooling system used for aircrafts.

e. Write a short note on the factors affecting comfort air conditioning.

f. Which material is commonly used for making ducts in the air conditioning systems?

2. a. A Vapour Compression Refrigeration System using Ammonia works between -25 °C and 40 °C as evaporator & condenser temperature respectively. Using P-h chart, Determine: [12]
1. COP.
2. Mass of Refrigerant per TR.
3. Piston Displacement per TR using Volumetric Efficiency of 83 %.
4. Heat Rejected in the Condenser per TR.
5. Ideal COP.

b. Explain construction and working of simple vapour absorption refrigeration system with neat sketch. [08]

3. a. Sketch the T-s and p-h diagrams for the vapour compression cycles when the vapour after compression is i) Dry Saturated ii) Wet [08]

b. An air-cooling system for a jet plane cockpit operates on the simple cycle. The cockpit is to be maintained at 25 °C. The ambient air pressure and temperature are 0.35 bar and -15 °C, respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1000 kilometres per hour. The pressure drop through the cooler coil is 0.1 bar. The pressure of the air leaving the cooling turbine is 1.06 bar and that in the cockpit is 1.0325 bar. The cockpit cooling load is 58.05 TR. The temperature of air leaving the coder is 50 °C. [12]
1. Temperature and pressure at all the points.
2. Mass of air circulated per minute
3. COP

4 a. Explain the working principle of thermostatic expansion valve with the help of a neat diagram. [08]

b. A sample of moist air has Dry Bulb Temperature is 22 °C and Relative Humidity is 30 %. Barometric Pressure is 760 mm of Hg. Determine the following properties by using steam table and Verify your results with Psychrometric chart. [12]

1. Vapour Pressure.
2. Dew Point Temperature.
3. Specific Humidity.
4. Enthalpy of the mixture.

5 a. A rectangular duct section of 500 mm x 350 mm size carries 75 m^3/min of air having density of 1.15 Kg/m^3. Determine the equivalent diameter of a circular duct if (a) the quantity of air carried in both the cases is same, and (b) the velocity of air for both the cases is same. If f = 0.01 for sheet metal, find the pressure loss per 100 m length of duct. [08]

b. An air conditioning plant is required to supply 60 m^3 of air per minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. [08]

c. What are the desirable properties of an ideal refrigerants? [04]

6 **Write a note on following (any Four).** [20]

a. Dairy and food processing plant

b. What is the function of the following components in an absorption system:
(i) Absorber (ii) Rectifier (iii) Analyzer (iv) Heat exchangers.

c. What are the factors affecting the comfort air conditioning.

d. Explain the working of Heat Pump and state the applications.

e. Show the following processes on the skeleton psychrometric chart:
(a) Dehumidification of moist air by cooling; and
(b) Adiabatic mixing of two air streams.

f. Prove that the performance factor of a Bell-Coleman Cycle refrigeration systems is given by $C.O.P. = \frac{T_2}{T_3 - T_2}$

Where T_2 and T_3 are the temperatures of air at the inlet and discharge of compressor resp.

****

TE - Sem-VI - Mech - R-19 QP: 10097663

(3 Hours) [Total marks: 80]

Instructions:
1. **Question 1 compulsory.**
2. Attempt any **three** questions from the remaining **five** questions.
3. Figures to the right indicate full marks.
4. Assume suitable data wherever required but justify the same.

Q.1.		Solve **ANY FOUR** questions from following.	
	a	What are the main elements of an automated system? Describe each briefly.	**05**
	b	What is a tree search? How is it used in AI problem-solving?	**05**
	c	What are the degrees of freedom in a robot? Give example.	**05**
	d	Explain the concept of Natural Language Processing (NLP) and its relevance in automation systems	**05**
	e	Explain the working principle of a 5/2 double solenoid valve.	**05**
Q.2.	a.	Draw a regenerative hydraulic circuit and explain its working.	**10**
	b	Explain the types of drives and transmission systems used in robots	**10**
Q.3.	a.	Explain depth-first search (DFS) and breadth-first search (BFS). Compare their advantages and limitations.	**10**
	b.	Design an electro- pneumatic circuit for two-cylinder operation with following sequence using 5/2 both side solenoid operated valve as DCV. A+ , Delay B+ , (AB) –	**10**
Q.4	a.	Design a hydraulic circuit for two cylinder operation with following sequence using 4/2 pilot operated valve as DCV using cascade method. A+ , B+ , Delay B- , A-	**10**
	b	Define and explain the types of intelligent agents in AI.	**10**
Q.5.	a.	Define Timers, Counters, Flags, and Latching in PLC-controlled pneumatic systems.	**10**
	c.	Explain the purpose of a counterbalance valve in a hydraulic system and describe how it functions.	**10**
Q.6	a.	What are genetic algorithms, and explain how are they used for optimization in automation?	**10**
	b.	List any four limitations of regression models in AI?	**05**
	c	Illustrate K nearest neighbours algorithm used in machine learning.	**05**

****

QP code: 10082797

TE sem VI Mechanical R-19 Cscheme

Time: 3 hour **Max Marks:80**

Note: 1. Q1 is compulsory
2. Solve any three from remaining
3. Assume suitable data wherever required

Q1 **Solve any Four out of Seven** 20

A. Define metal forming processes and explain metal forming process with stress – strain diagram
B. Discuss various rolling defects in detail
C. Classify forging processes and any one forging process
D. Define extrusion metal forming process with its working zone and sketches
E. Explain wire drawing process with its advantages, disadvantages
F. Classify metal spinning operation and list out its process parameters

Q2 A. Explain Mechanism of plastic deformation (i) By slip (ii) By Twinning with sketches **10**

B. The true stress – true stain curve is given by $\sigma = 1500\epsilon^{0.45}$ Determine maximum flow stress , true strain ϵ =0.5 **5**

C. Differentiate Hot and Cold working with sketches **5**

Q3 A. The thickness of plate is reduced from 30 mm to 10 mm by successive cold rolling passes using identical rolls of diameter 600 mm. Assume that there is no change in width and coefficient of friction between the rolls and the work piece is 0.1. Calculate the minimum number of passes required. **10**

B. Explain the effect of temperature and strain rate on metal forming? . **10**

Q4 A. Determine drawing stress and velocity for a wire having entry diameter of 3.0mm and outer diameter 2.04mm Given characteristics of wire drawing as K =350MPa, μ = 0.08, n = 0.01, α =18degree and power required for drawing is 608Watt. **10**

B. Explain tube drawing process. With diagrams **10**

Q5 **A.** Determine the number of draws if a cup of 90mm height and 45mm dia is to be made from steel metal sheet stock 3mm thickness. Also, the diameter of different stages of redraw. Assume, reduction in 1st, 2nd and 3rd draw are 40%, 25%, 20% respectively **10**

B. A 85mm long cylindrical billet of diameter 50mm is reduced by indirect extrusion to 10mm. The average flow stress of material is 450MPa. Take a = 0.8, b = 1.5 for the Johnson formula Fine(i) True strain, (ii) Ram force, (iii) power if ram speed is 0.6 m / min $r_x = 4$ **10**

Q6 A. Explain explosive forming process with advantages, limitations, and applications **10**

B. Explain metal spinning machine with schematic diagram with its construction **10**

QP code : 10082430

TE sem VI Mechanical R-19 Cscheme

Duration: 3hrs **[Max Marks: 80]**

N.B. **(1)** All questions carry equal marks.
(2) Question No. 1 is Compulsory.
(3) Attempt any three questions from remaining five questions.
(4) Figures to the right indicate full marks.
(5) Assume Suitable data if necessary.

Que. 1 Attempt any **four** of the following: **(20)**

A. Prove that in metal cutting, chip flow velocity = cutting velocity × chip thickness ratio ($V_c = V \times r$).

B. Explain primary and secondary cutting edge finish.

C. Explain the various elements of a single point cutting tool, with the help of a neat sketch.

D. Explain the sources of heat generation in metal cutting with the help of sketches.

E. Sketch a twist drill and name all elements also write briefly on the following elements: Helix angle, chisel angle and point angle.

F Explain the crater wear and flank wear with the help of sketches.

Que. 2 A. Calculate and Design a round pull type broach for machining hole of diameter **35H7** and length **20** mm in a work piece of carbon steel. **(10)**
Specific cutting force = **4200** N/ mm^2, **IT7** = **0.025** mm, Tooth rise = **0.03** mm, Cutting speed in broaching = 8 m/min and Blunt broach factor = **1.25**. Draw the broach and indicate designed value.

B. What are the advantages of indexable inserts (tipped tool)? How can indexable inserts and their holders are specified (ISO coding)? **(10)**

Que. 3 A. The following data relate to an orthogonal turning process: **(10)**
Chip thickness = 0. 45 mm, Feed = 0.25 mm/ rev, Cutting speed = 2.5 m/sec, Rake angle = 10^0

(i) Calculate cutting ratio and chip reduction coefficient.
(ii) Calculate shear angle
(iii) Calculate shear velocity and chip velocity

B. Name and explain the various materials used for cutting tools. **(10)**

Que. 4 A. The following equation for tool life is given for a turning operation: (10)

$$V\,T^{0.13}\,f^{0.77}\,d^{0.37} = C$$

A 60 minute tool life was obtained while cutting at V = 30 m/min, f = 0.3 mm/rev, and d = 2.5mm. Where; V = cutting speed in m/min, T = Tool life in min, f = feed in mm/rev, and d = depth of cut in mm.

Determine the change in tool life if the cutting speed, feed and depth of cut are increased by 20% individually and also taken together.

B. Derive an expression for shear plane angle in terms of friction angle and rake angle for minimum rate of energy consumption. Also state your assumptions. (10)

Que. 5 A. For a turning operation, derive relationship for optimum cutting speed and optimum tool life for minimum cost criteria in metal cutting. (10)

B (I) Explain tool work thermocouple method with sketch for cutting temperature measurement. (10)
(II) How is the tool shank of a single point cutting tool designed?

Que. 6 A. (I) Explain working principle of Strain gauge type dynamometer.with the help of neat schematic sketch. (10)
(II) What are the functions and essential properties of a cutting fluid?

B. Sketch and name all elements of a **Solid Tap**, and discuss their design features. (10)

ap.code: 10083577

TE sem VI Mechanical R-19 C scheme

Time: 3 Hours **Total Marks: 80**

Note: 1) Question No.1 is **Compulsory**
2) Attempt any three questions out of the remaining five questions.
3) Figures to the right indicate full marks.
4) Assume suitable data wherever required.

Q1 Attempt any four **(20)**

A. Explain the impact of automation on productivity and cost in manufacturing systems.
B. What is the difference between uninformed and informed search algorithms? Explain with examples.
C. What are the basic components of an Artificial Neural Network? List and explain briefly.
D. Define a point-to-point control system used in the robotic system with suitable applications.
E. What is latching in PLC programming? Draw a ladder diagram to demonstrate latching using a push button.

Q2 A Design simple pneumatic circuit for two-cylinder operation with the following sequence using 4/2 pilot-operated valve as DCV using cascade method **(10)**
Delay B+ A+ A- B-, With user option of single cycle – multi cycle. Also draw displacement diagram.

B Compare supervised learning with unsupervised learning. Discuss their major differences in data labelling, model training, and algorithm use. **(10)**

Q3 A What is meant by agent and explain its types with reference to Artificial Intelligence. (include sketches) **(10)**

B Illustrate with neat sketches mechanical and magnetic type of end effectors used in robotic system, stating its advantages and disadvantages. **(10)**

Q4 A Compare BFS and DFS based on the following parameters: **(10)**
i) Approach (Strategy), ii) Data structure used, iii) Time complexity, iv) Space complexity,
v) Completeness and optimality

B Illustrate with neat sketch hydraulic intensifier circuits. **(10)**

Q5 A Design electro-pneumatic circuit for two-cylinder operation with the following sequence using 5/2 both side solenoid-operated valve as DCV. **(10)**
A+B+Delay B- A- , With user selection option single cycle Multicycle operation.

B How do pitch, yaw, and roll relate to the degrees of freedom in a robot? Explain with examples. **(05)**

C Illustrate with neat sketches, the logic of AND and OR gates, used in operation of pneumatic circuits. **(05)**

Q6 A Define Natural Language Processing (NLP). Explain its role and applications in industrial automation. **(10)**

B Differentiate between PLC and Relays. **(05)**

C Illustrate K nearest neighbours algorithm used in machine learning. **(05)**

QP code : 10083835

TE sem VI Mechanical R-19 Cscheme

Time: 3Hrs **Marks:80**

NB:

1. **Question No.1** is compulsory
2. Attempt **any three questions from the remaining questions.**
3. **All questions carry equal marks.**
4. **Assume suitable data** if necessary and **state it clearly.**
5. **Use of Refrigerant tables, Friction Charts, Psychrometric Charts, and Steam Tables are permitted.**

1 **Answer any four from the following** **20**

a. Explain the classification of refrigerants with an example. **5**

b. A machine working on a Carnot cycle operates between 305 K and 260 K. Determine the C.O.P. when it is operated as: 1. A refrigerating machine; 2. A Heat Pump, and 3. a heat engine. **5**

c. Write a note on a Heat Pump. **5**

d. Define the term 'effective temperature' and explain its significance in the design of air conditioning systems. **5**

e. State the types of Expansion device and explain the working of any one with neat diagram. **5**

f. State the various applications of HVACR and explain any one application. **5**

2 a. Draw a neat diagram of a three-fluid system of refrigeration (Electrolux refrigeration system) and explain its working. **08**

b. A Simple evaporative air refrigeration system is used for an aeroplane to take 20 tonnes of refrigeration load. The ambient air conditions are 20°C and 0.9 bar. The ambient air is rammed isentropically to a pressure of 1 bar. The air leaving the main compressor at pressure 3.5 bar is first cooled in the heat exchanger having effectiveness of 0. 6 and then in the evaporator where its temperature is reduced by 5°C. The air from the evaporator is passed through the cooling turbine, and then it is supplied to the cabin, which is to be maintained at a temperature of 25°C and at a pressure of 1.05 bar. If the internal efficiency of the compressor is 80% and that of cooling turbine is 75%, determine: 1. Mass of air bled off the main compressor; 2. Power required for the refrigerating system, and 3. C.O.P. of the refrigerating system. **12**

3 a. A vapour compression refrigerator uses R-12 as refrigerant and the liquid evaporates in the evaporator at - 15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. Find the coefficient performance if (i) there is no undercooling, and (ii) the liquid is cooled by 5°C before expansion by throttling. **10**

Take specific heat at constant pressure for the superheated vapour as 0.64 kJ/kg K, and that for liquid as 0.94 kJ/kg K. The other properties of refrigerant are as follows:

Temperature in °C	Enthalpy in kJ/ kg		Specific entropy in kJ/kg K	
	Liquid	Vapour	Liquid	Vapour
-15	22.3	180.33	0.0904	0.7051
10	45.4	191.76	0.1750	0.6921

b. A vapor compression cycle using refrigerant R-22 operates at a condensing temperature of 34°C and an evaporative temperature of -10°C. For a mass flow rate of the refrigerant equal to 0.33 kg/s. **Determine the following: Use p-h chart**: 1. The compressor power; 2. The refrigerating effect; 3. The coefficient of performance. 10

4 a. Explain various psychrometric processes. 08

b. The following data refer to air conditioning of a public hall: 12
Outdoor conditions = 40°C DBT, 20°C WBT
Required comfort conditions = 20°C, DBT, 50% RH
Seating capacity of hall = 1000
Amount of outdoor air supplied = 0.3 m^3/min/person
If the required condition is achieved first by adiabatic humidifying and then cooling, find:
1. The capacity of the cooling coil and surface temperature of the coil if the by-pass factor is 0.25, and 2. The capacity of the humidifier and its efficiency

5 a .800 m^3/min of recirculated air at 22^0C DBT and 10^0C dew point temperature is to be mixed with 300 m^3/min of fresh air at 30^0C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio, and dew point temperature of the mixture. Determine: 10
a. Enthalpy
b. Humidity Ratio
c. Specific volume and
d. DPT of the mixture

b Draw a neat sketch of Air Handling Unit showing each component. Also, state the functions of each component. 10

6 a A duct of 15m length passes air at the rate of 90 m^3/min. Assuming the friction factor as 0.005, calculate the pressure drop in the duct in mm of water when (a) the duct is circular of diameter 0.3 m; and (b) the duct is of 0.3 m square cross-section. 10

b **Answer Any TWO.** 10
1. Define human comfort. Explain the factors affecting human comfort. 5
2. Define: i) Ton of Refrigeration ii) Bypass Factor iii) Dry bulb temperature iv) Wet bulb temperature v) Humidity ratio 5
3. Dairy and food processing plant 5

****

QP code : 10083296

TE sem VI Mechanical R-19 C scheme

16 MAY 2025

Time:3 Hours

Marks: 80

Instructions:

- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining FIVE** questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.
- Use of steam table is permitted.

			Marks
Q. 1		Solve **ANY FOUR** questions from following. (Each question carries 5 marks)	**(20)**
	a)	Describe construction and working of Economiser with neat sketch.	
	b)	Write short note on compounding of Impulse turbine.	
	c)	Explain the construction and working of double acting reciprocating pump with neat sketch.	
	d)	Illustrate impulse momentum principle and reaction principle in Hydraulic turbines.	
	e)	What is surging and chocking in compressor.	
Q. 2	**a)**	A Pelton wheel is to designed for the following specification: Power (Brake or Shaft) = 9560 kW, Head = 350 m, Speed = 800 RPM, Overall efficiency = 85%, Jet Diameter is limited to $1/6^{th}$ of the wheel diameter. Determine the wheel diameter. diameter of jet and number of jet required. Take C_v=0.985 and speed ratio = 0.45.	**(10)**
	b)	Illustrate working of La-Mont boiler and Once through boiler with the help of neat sketch.	**(10)**
Q. 3	**a)**	In a gas turbine plant , the air enters a compressor from ambient at a pressure of 1 bar and 10°C. The static pressure at the suction of the compressor is 0.9 bar and compresses it to total pressure of 6.0 bar and a total temperature of 230°C. The air expands in the turbine upto a total pressure of 1 bar and total temperature of 460°C. The net output of the turbine is 1930 kW. Calculate: i) Total head isentropic efficiency of the compressor. ii) Velocity at entrance to the compressor iii) Mass flow rate if the area at entry to the compressor is 0.1 m^2. iv) The temperature of gases at the entry to the turbine. Neglect all other losses and the mass of fuel. Assume C_{pa} = 1.05 kJ/kg K for compressor, C_{pg} = 1.13 kJ/kg K for turbine, γ =1.4 throught and R=300 Nm/kg K for air.	**(10)**
	b)	State and derive the expression for equivalent evaporation of boiler and boiler efficiency?	**(10)**

Q. 4 a) The following data is recorded during a trial on a boiler: Duration of trial=8 hrs., Pressure of steam leaving the boiler = 14 bar, Condition of steam leaving the boiler = 0.973 dry, Feed water evaporated = 26700 kg, Temperature of feed water at inlet = 50 °C, Mass of coal fired = 4260 kg, Calorific value of coal fired = 28900 kJ/kg, Air supplied per kg of coal fired = 17 kg, Temperature of flue gas leaving boiler = 344 °C, Boiler house temperature = 21 °C, Specific heat of flue gases at constant pressure = 1.1 kJ/kg K. Determine i) Boiler efficiency ii) Equivalent evaporation iii) Heat lost to flue gases. (10)

b) Draw a general layout of a hydroelectric power plant using a Pelton turbine and define the following: (a) Gross head, (b) Net head, (c) Mechanical efficiency (d) Overall efficiency of the Pelton turbine. (05)

c) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. (05)

Q. 5 a) A centrifugal pump having outer diameters equal to two times the inner diameters and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm. Determine: (10)
(i) Inlet vane angle,
(ii) Work done by the impeller on water per second, and
(iii) Manometric efficiency

b) What is Euler's theory? What is the use of it in pump and turbine (05)

c) Illustrate working of Turboprop Engine. (05)

Q. 6 a) A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine the volume flow rate and the power developed by the turbine. (10)

b) Derive an expression for condition to get maximum efficiency in De-laval turbine. (10)

----------XX----------XX----------XX----------

QP code : 10081281

T.E Sem VI Mechanical R-19 C scheme

[03 Hours] [Total marks – 80]

N.B. 1. Question No 1 is **compulsory**
2. Solve **Any Three** questions from the remaining **Five** questions.
3. Assume any **suitable data** if necessary with justification.
4. Use of **Standard Data Book** is permitted
5. Figures to the right indicate full marks.

Q1. Attempt any **Four** of the following. **20**

(a) Explain self-locking and Overhauling Screws? **05**

(b) List out the design considerations in casting & Forging **05**

(c) Explain Nipping of leaf spring **05**

(d) Differentiate between hydrostatic bearing and hydrodynamic bearing? **05**

(e) Define stress concentration and with neat sketches explain various methods to reduce the effect of stress concentration. **05**

Q2. (a) Design a Socket and Spigot Cotter Joint for an axial load of 20 kN by selecting suitable material. Check Cotter for bending and draw the neat sketch of joint. **15**

(b) Explain surge in spring with the methods to eliminate it. **05**

Q3. (a) Determine the suitable diameter for the solid shaft, if it is supported by two bearings placed 800 mm apart. A 300 mm diameter pulley is mounted at a distance of 250 mm to the right of left hand bearing and this drives a pulley directly below it with the belt. Another pulley 400 mm diameter is placed 350 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulley is 180° & $\mu = 0.3$. The shaft transmits 12 KW at 1440 rpm and weight of pulley A is 300 N and that of B is 450 N. Assume that the torque of one pulley is equal to that of the other pulley. **15**

(b) A piston rod of hydraulic cylinder exerts an operating force of 10kN. The friction due to piston packing and stuffing box is equivalent to 10 % of operating force. The pressure in the cylinder is 10 MPa. The cylinder is made of Cast Iron, FG 200 and Factor of safety is 5. Determine the diameter and thickness of cylinder. **05**

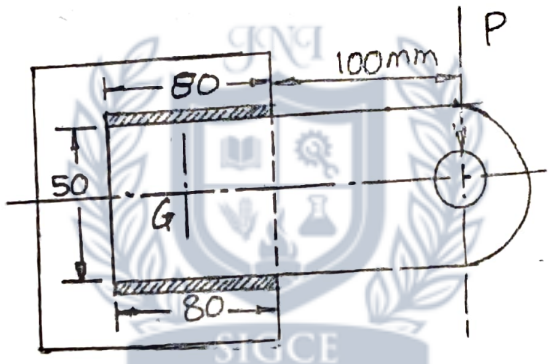
Q4. (a) DGBB is subjected to a radial load of 5 KN and axial load of 2.5 KN when operating on 600 rpm. Consider the expected life of 20000 hours with survival probability of 93%. Select suitable standard bearing from the manufacturer's catalogue. **10**

(b) A radial load on 360^0 hydro dynamically lubricated self-contained bearing supports 10kN. The journal rotates at 1450 rpm. Assuming journal length to it diameter as 1 with the bearing length as 50 mm. Take radial clearance as 20 microns, eccentricity as 20 microns, specific gravity of lubricants as 0.86, specific heat of lubricants 2.09 kJ/kg ^{0}C. Find, 10

i. Oil film thickness.
ii. Coefficient of friction.
iii. Viscosity

Q5. (a) A protected type flange coupling is required to transmit 20 kW at 900 r.p.m. Design the coupling by selecting suitable materials for various component. 10

(b) A plate welded to a channel as shown in fig. no.1, is subjected to an eccentric load P= 8 KN. Determine the size of weld if the permissible shear stress for the weld is not to exceed 80 MPa. 10



(Fig. No.1)

Q6. (a) A single cylinder four stroke cycle internal combustion engine produces 15 KW power at 700 rpm. Design a suitable flywheel, assuming coefficient of fluctuation of speed as 0.04. The torque developed during the power stroke may be considered as sine curve and work done during the power stroke is 30% more than the work done per cycle. 12

(b) Determine the size of rubber canvas belt to transmit 5 kW from an electric motor rotating at 960 rpm to an intermediate shaft of a machine tool. The approximate reduction ratio is 2.8 and expected life is 1200 hours. Also check for induced stress in the belt. 08

****

QP code : 10095302

TE sem VI Mechanical R-19 Cscheme

Time: 3 hour **Max. Marks: 80**

Instructions:

- **Question No.1 is compulsory.**
- Solve **ANY THREE** questions from the **remaining** five questions.
- Figure to the right indicates full marks.
- Assume suitable data wherever required, but justify the same.
- Use of steam table is permitted.

Q. 1 Solve **ANY FOUR** questions from following. **(Each question carries 5 marks)** **(20)**

a) Describe construction and working of Economizer with neat sketch.

b) Explain the different methods of improving efficiency of steam turbine?

c) Describe construction and working double acting reciprocating pump with neat sketch.

d) What is the necessity of multistage compression? and why intercooling required between stages?

e) Explain construction and working of closed cycle gas turbine power plant.

Q. 2 **a)** A Pelton wheel is to designed for the following specification: **(10)**
Power (Brake or Shaft) = 9560 kW, Head = 350 m, Speed = 800 RPM, Overall efficiency = 85%, Jet Diameter is limited to $1/6^{th}$ of the wheel diameter. Determine the wheel diameter, diameter of jet and number of jet required. Take C_v=0.985 and speed ratio = 0.45.

b) Differentiate between fire tube and water tube boiler. **(05)**

c) Explain the construction and working of Ramjet Engine with sketch. **(05)**

Q. 3 **a)** In a gas turbine plant , the pressure ratio, through which air at 15 °C is compressed, is 6. The same air is then heated to a maximum possible temperature of 750 °C first in a heat exchanger which is 75% efficient and then in the combustion chamber. The same air at 750 °C is expanded in two stage such that expansion work is maximum. The air is reheated to 750 °C after the first stage. Determine the cycle thermal efficiency, work raio and net shaft work per kg of air. Assuming the isentropic efficiency of compressor stage as 80% and that of turbine as 85%. Assumed that C_p = 1.005 kJ/kgK and γ = 1.4. **(10)**

b) Draw a general layout of a hydroelectric power plant using a Pelton turbine and define the following: (a) Gross head, (b) Net head, (c) Mechanical efficiency (d) Overall efficiency of the Pelton turbine. **(05)**

c) What is cavitation? How it is avoided in reciprocating pumps? **(05)**

Q. 4 a) Calculate equivalent evaporation and efficiency of the boiler for the following data: Pressure of steam =9 bar, Quality of steam = 0.97 dry, Quantity of steam = 5600 kg/hrs., Temperature of feed water = 36 °C, Coal consumption = 700 kg/hrs., Calorific value of coal = 31380 kJ/kg of fuel. (At P=9 bar, take: h_f =742.6 kJ/kg and h_{fg} =2029.5 kJ/kg.) **(10)**

b) Draw an indicator diagram, considering the effect of acceleration and friction in suction and delivery pipes. **(05)**

c) What is surging and chocking in compressor. **(05)**

Q. 5 a) A centrifugal pump impeller has diameters at inlet and outlet as 350 mm and 700 mm respectively. The flow velocity at outlet is 2.3 m/s and vanes are set back at an angle of 45° at the outlet. If the manometric efficiency is 75%, calculate the minimum starting speed of the pump. **(10)**

b) Describe Pressure-velocity compounding of Impulse turbine ? **(05)**

c) Describe construction and working of once through boiler with neat sketch. **(05)**

Q. 6 a) In an inward flow reaction turbine the head on the turbine is 31 m. The external and internal diameters are 1.4 m and 0.7 m respectively. The velocity of flow through the runner is constant and is equal to 3.3 m/s. The guide blade angle is 11° and the runner veins are radial at inlet. If the discharge at the outlet is radial determine: (i) The speed of the turbine, (ii) The vane angle at outlet of the runner and (iii) Hydraulic efficiency. **(10)**

b) Explain construction and working of Turboprop engine with neat sketch. **(05)**

c) What is mean by priming? Explain its necessity in centrifugal pump? **(05)**

****

Machine design QP code : 10097407

TE sem VI Mechanical R-19 Cscheme

[03 Hours] [Total marks – 80]

N.B.: 1. Question No **1** is **compulsory**
2. Solve **Any Three** questions from the remaining **Five** questions.
3. Assume any **suitable data** if necessary with justification.
4. Use of **Standard Data Book** is permitted
5. Figures to the right indicate full marks.

Q1. Attempt any **Four** of the following. **20**

(a) State the characteristics of chain drive and discuss the polygon effect. **05**

(b) List out the design considerations in casting & Forging **05**

(c) Explain the nipping of the leaf spring with neat sketch **05**

(d) Explain self-locking and Overhauling Screws? **05**

(e) Define stress concentration and with neat sketches explain various methods to reduce the effect of stress concentration. **05**

Q2. **(a)** Design a Socket and Spigot Cotter Joint for an axial load of 20 KN by selecting suitable material. Check Cotter for bending and draw the neat sketch of joint. **15**

(b) Why and what value of taper is provided on Cotter? **05**

Q3. **(a)** The shaft is supported in bearings 800 mm apart and transmits 10 KW at 960 R.P.M. through a pulley 'C' of 300 mm diameter which is mounted at 350 mm to the right of left hand bearing. The angle of lap is 180° and coefficient of friction between the belt & the pulley is 0.3. Select suitable material and design the shaft. Take belt tensions at pulley 'C' as vertically downward. The pulley 'C' weighs 400 N. Sketch the arrangement. **15**

(b) The piston rod of a hydraulic cylinder exerts an operating force of 10 KN. The friction due to piston packing and stuffing box is equivalent to 10% of operating forces. The pressure in cylinder is 10 MPa. The cylinder is made of C.I. with σt =50 MPa. Determine thickness of cylinder using Lame's equation. **05**

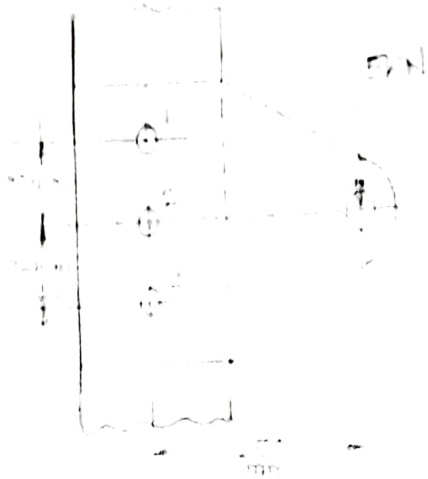
Q4. **(a)** DGBB is subjected to a radial load of 6 KN and axial load of 2 KN when operating on 500 rpm. Consider the expected life of 20000 hours with survival probability of 92%. Select suitable standard bearing from the manufacturer's catalogue. **10**

(b) A radial load on 360^0 hydro dynamically lubricated self-contained bearing supports 10kN. The journal rotates at 1440 rpm. Assuming journal length to it diameter as 1 with the bearing length as 50 mm. Take radial clearance as 20 microns, eccentricity as 20 microns, specific gravity of lubricants as 0.86, specific heat of lubricants 2.09 kJ/kg ^{0}C. Find, **10**

i. Oil film thickness.
ii. Coefficient of friction.
iii. Viscosity

Q5. **(a)** A protected type flange coupling is required to transmit 12 KW at 960 r.p.m. Design the coupling by selecting suitable materials for various component. **10**

(b) A steel plate is subjected to a force of 5 KN and fixed to a channel by means of 3 identical bolts as shown in fig. no.1. Determine the size of weld if the permissible shear stress for the weld is not to exceed 50 MPa. **10**



(Fig. No.1)

Q6. **(a)** 75 kW power is transmitted by multi-plate clutch at 3000 rpm. The plates run in oil and coefficient of friction is 0.07. Axial intensity of pressure is not to exceed 0.15 N/mm^2. Due to space limitation external radius is restricted to 125 mm. Assuming number of springs as 6. **10**

i. Design input and output shaft. ii. Design friction and pressure plates.

(b) A flat belt drive is used to transmit 6 kW power from an electric motor rotating at 1440 rpm to the blower operating at 400 rpm for 10 hours/ day and the expected life of belt is two and half years approximately. Centre to centre distance is 950 mm. Find **10**

a. Driving and Driven pulley diameter.
b. Considering Rubber Canvas Material for the belt, determine the thickness and width of the belt.

****

TE - VI - Mech - R-19 GP: 10094345

(03 HOURS) **(MAX. MARKS : 80)**

Note:

1. Question **No. 1** is compulsory.
2. Attempt **any three** questions out of remaining **five** questions.
3. Assume suitable data wherever necessary.
4. Figures to right indicate full marks.

			Marks
Q.1		Answer the following **(Any four)**	
	a.	Differentiate hot and cold extrusion process	05
	b.	Explain the effect of temperature and strain rate in metal forming process.	05
	c.	Define sheet metal bending process explain with sketches either V-bending or Edge Bending	05
	d.	Explain various defects in forging.	05
	e.	Classify metal forming processes.	05
Q.2	a.	Differentaite forward and backward extrusion.	10
	b.	In a cold extrusion of aluminum (K=140 MPa, n=0.25), 10 cm diameter billet to a diameter of 5 cm at 1 m/min the billet is initially 25 cm long. Determine the extrusion force and power.	10
Q.3	a.	In a single pass rolling operation, a 20 mm thick plate with plate width of 100 mm, is reduced to 18 mm. The roller radius is 250 mm and rotational speed is 10 rpm. The average flow stress for the plate material is 300 MPa. Calculate the power required for the rolling operation in kW.	10
	b.	Classify rolling processes. Write the advantages and limitations of it.	10
Q.4	a.	In a wire drawing operation, the initial wire diameter is 7 mm and final wire diameter is 6.3 mm. the half die angle $\alpha=10^0$. Find the drawing stress considering $\mu=0.1$ and $k=20$ N/mm^2. Also calculate the maximum reduction possible.	10
	b.	Explain tube drawing process.	10
Q.5	a.	Classify forging and write advantages and limitations of open and close die forging.	10
	b.	What is flash? Why is it provided in forging? Explain upsetting and fullering operations in forging.	10
Q.6	a.	What is HERF processes? Write advantages, limitations, and applications of it.	10
	b.	Explain magnetic pulse forming process with advantages, limitations and applications.	10

TE - VI - Mech - R-19

QP: 10095939

Duration: 3hrs **Marks: 80**

N.B. **(1)** All questions carry equal marks.
(2) Question No. 1 is Compulsory.
(3) Attempt any three questions from remaining five questions.
(4) Figures to the right indicate full marks.
(5) Draw neat sketches wherever necessary.

Q. 1 Attempt any **four** of the following: (20)

A. Explain the ISO coding system for tool holders and its significance.
B. Explain the formation and effects of Built-Up Edge (BUE) on surface quality.
C. Explain the functions of roughing, semi-finishing and finishing teeth in a broach.
D. Explain the Merchant's force circle with neat sketch.
E. Explain the concept of MQL (Minimum Quantity Lubrication) and Cryogenic Cooling.
F. Explain the economics of metal cutting and its significance in manufacturing.

Q. 2 A. During an orthogonal machining (turning) operation of C – 40 steel, the following data were obtained: (10)
Chip thickness = 0.45 mm, Width of cut = 2.5 mm, Feed = 0.25 mm/rev, Tangential cut force = 1130 N, Feed thrust force = 295 N, Cutting speed = 2.5 m/sec, Rake angle = 10^0
Calculate: (a) Force of shear at the shear plane, (b) Kinetic co-efficient of friction at the chip – tool interface.

B. Explain the types of tool wear mechanisms and the factors affecting tool life. (10)

Q. 3 A. Draw single point cutting tool diagram with signature and explain the important elements from the machining point of view. (10)

B. For a metal machining following information is available: (10)
Tool changing time = 8 min, Tool regrinding time = 5min, M/c running cost = Rs 30/ hr, Tool depreciation / regrind = Rs 1.2, Tool life equation $VT^{0.25} = 150$. Calculate optimum cutting speed and tool life for minimum cost of production.

Q. 4 A. Draw and label the parts of a face-milling cutter and explain their functions. (10)
B. Explain the mechanics of chip formation and derive the expression for shear angle. (10)

Q. 5 A. Discuss in detail the properties and classification of cutting tool materials. (10)
B. (I) Explain lathe turning dynamometer with neat sketch. (10)
(II) State the action of cutting fluid and lubricants.

Q. 6 A. Draw and label a twist drill and explain the function of each part. (10)
B. Explain tool design for USM, including tool material, shape and abrasive flow. (10)

****

TE - Sem-VI - Mech - R-19 GP: 10097663

(3 Hours) [Total marks: 80]

Instructions:
1. **Question 1 compulsory**.
2. Attempt any **three** questions from the remaining **five** questions.
3. Figures to the right indicate full marks.
4. Assume suitable data wherever required but justify the same.

Q.1. Solve **ANY FOUR** questions from following.

	a	What are the main elements of an automated system? Describe each briefly.	05
	b	What is a tree search? How is it used in AI problem-solving?	05
	c	What are the degrees of freedom in a robot? Give example.	05
	d	Explain the concept of Natural Language Processing (NLP) and its relevance in automation systems	05
	e	Explain the working principle of a 5/2 double solenoid valve.	05
Q.2.	a.	Draw a regenerative hydraulic circuit and explain its working.	10
	b	Explain the types of drives and transmission systems used in robots	10
Q.3.	a.	Explain depth-first search (DFS) and breadth-first search (BFS). Compare their advantages and limitations.	10
	b.	Design an electro- pneumatic circuit for two-cylinder operation with following sequence using 5/2 both side solenoid operated valve as DCV. A+ , Delay B+ , (AB) –	10
Q.4	a.	Design a hydraulic circuit for two cylinder operation with following sequence using 4/2 pilot operated valve as DCV using cascade method. A+ , B+ , Delay B- , A-	10
	b	Define and explain the types of intelligent agents in AI.	10
Q.5.	a.	Define Timers, Counters, Flags, and Latching in PLC-controlled pneumatic systems.	10
	c.	Explain the purpose of a counterbalance valve in a hydraulic system and describe how it functions.	10
Q.6	a.	What are genetic algorithms, and explain how are they used for optimization in automation?	10
	b.	List any four limitations of regression models in AI?	05
	c	Illustrate K nearest neighbours algorithm used in machine learning.	05

****

TE - Sem - VI - Mech - R-19

QP : 20000218

[Max Marks:80]

Duration: 3 Hrs

N.B.: 1. Question No.1 is compulsory
2. Attempt any three questions from the remaining questions.
3. All questions carry equal marks.
4. Assume suitable data if necessary and state it clearly.
5. Use of Refrigerant tables, Friction Charts, Psychrometric Charts, and Steam Tables are permitted.

[20]

1. Answer ANY FOUR from the following.

a. Define human comfort. Explain the factors affecting human comfort.
b. Define the term 'effective temperature' and explain its significance in the design of air conditioning systems.
c. Define: i) Ton of Refrigeration ii) Bypass Factor iii) Dry bulb temperature iv) Wet bulb temperature v) Humidity ratio
d. Explain the working of a simple air cycle cooling system used for aircrafts.
e. Write a short note on the factors affecting comfort air conditioning.
f. Which material is commonly used for making ducts in the air conditioning systems?

2. a. A Vapour Compression Refrigeration System using Ammonia works between -25 °C and 40 °C as evaporator & condenser temperature respectively. Using P-h chart, Determine; [12]
1. COP.
2. Mass of Refrigerant per TR.
3. Piston Displacement per TR using Volumetric Efficiency of 83 %.
4. Heat Rejected in the Condenser per TR.
5. Ideal COP.

b. Explain construction and working of simple vapour absorption refrigeration system with neat sketch. [08]

3. a. Sketch the T-s and p-h diagrams for the vapour compression cycles when the vapour after compression is i) Dry Saturated ii) Wet [08]

b. An air-cooling system for a jet plane cockpit operates on the simple cycle. The cockpit is to be maintained at 25 °C. The ambient air pressure and temperature are 0.35 bar and -15 °C, respectively. The pressure ratio of the jet compressor is 3. The plane speed is 1000 kilometres per hour. The pressure drop through the cooler coil is 0.1 bar. The pressure of the air leaving the cooling turbine is 1.06 bar and that in the cockpit is 1.0325 bar. The cockpit cooling load is 58.05 TR. The temperature of air leaving the coder is 50 °C. [12]
1. Temperature and pressure at all the points.
2. Mass of air circulated per minute
3. COP

4 a. Explain the working principle of thermostatic expansion valve with the help of a neat diagram. [08]

b. A sample of moist air has Dry Bulb Temperature is 22 °C and Relative Humidity is 30 %. Barometric Pressure is 760 mm of Hg. Determine the following properties by using steam table and Verify your results with Psychrometric chart. [12]

1. Vapour Pressure.
2. Dew Point Temperature.
3. Specific Humidity.
4. Enthalpy of the mixture.

5 a. A rectangular duct section of 500 mm x 350 mm size carries 75 m^3/min of air having density of 1.15 Kg/m^3. Determine the equivalent diameter of a circular duct if (a) the quantity of air carried in both the cases is same, and (b) the velocity of air for both the cases is same. If f = 0.01 for sheet metal, find the pressure loss per 100 m length of duct. [08]

b. An air conditioning plant is required to supply 60 m^3 of air per minute at a DBT of 21°C and 55% RH. The outside air is at DBT of 28°C and 60% RH. Determine the mass of water drained and capacity of the cooling coil. Assume the air conditioning plant first to dehumidify and then to cool the air. [08]

c. What are the desirable properties of an ideal refrigerants? [04]

6 **Write a note on following (any Four).** [20]

a. Dairy and food processing plant

b. What is the function of the following components in an absorption system:
(i) Absorber (ii) Rectifier (iii) Analyzer (iv) Heat exchangers.

c. What are the factors affecting the comfort air conditioning.

d. Explain the working of Heat Pump and state the applications.

e. Show the following processes on the skeleton psychrometric chart:
(a) Dehumidification of moist air by cooling; and
(b) Adiabatic mixing of two air streams.

f. Prove that the performance factor of a Bell-Coleman Cycle refrigeration systems is given by $C.O.P. = \frac{T_2}{T_3 - T_2}$

Where T_2 and T_3 are the temperatures of air at the inlet and discharge of compressor resp.

****