(3 hours) **Total Marks: 80**

NB 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 but justify the same.

Q1. Attempt any four (20)

A. State the difference in flexible automation and fixed automation with application.
B. Explain Automation migration strategy.
C. Define degree of Freedom (DOF) for robot. Explain robot anatomy with sketch.
D. Write short note on PLC Architecture.
E. Explain Linear regression and its application in Al.

Q2 A. Design electro Pneumatic circuit for two cylinder operation with following sequence using 5/2 both side solenoid operated valve as DCV. (10)
A+ Delay B+ A-B-

B. Explain concept of Artificial Neural Networks (ANN) in detail. List and define Terminologies of ANNs. (10)

Q3 A. List Agents used in Artificial Intelligence. Explain any two in detail. (10)
B. Explain Breadth first search Algorithm in detail with example (05)
C. Write short note on Logistic regression. (05)

Q4 A. Compare Supervised, Unsupervised and reinforcement learning with different parameters. (10)
B. Design simple hydraulic circuit for two cylinder operation with following sequence using 4/2 pilot operated valve as DCV using cascade method (10)
A+ B+ A- Delay B-
With user option of single cycle – multi cycle. Also draw displacement diagram.

Q5 A. Explain depth first search algorithm with example. (08)
B. Write note on different actuation methods for Direction control valves (08)
C. Explain tree and graph search. (04)

Q6 A. State and explain K-Means Clustering algorithm in detail. (08)
B. Write detail note on Meter in and Meter out circuits used in Hydraulics operations. (08)
C. Explain role and applications of timers and counters in PLC. (04)

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Time: 3 hour Max Marks:80

Note: 1. Q1 is compulsory
2. Solve any three from remaining

Q1		**Solve any Five out of six**	20
	a)	Differentiate hot and cold extrusion process	
	b)	Explain the effect of temperature in metal forming process.	
	c)	Explain Extrusion of pipes by cold working. With neat sketches.	
	d)	Explain defects in forging.	
	e)	Classification of forging process.	
	f)	Explain the concept of flow stresses.	
Q2	a)	Differentiate between open die and closed die forging Process.	10
	b)	Wire is dawn through a draw die with entrance angle 14degree, starting diameter is 2.75mm and final diameter is 2.25mm . The coefficient of friction at work die interface is 0.08. The metal has strength coefficient K = 215MPa and stain hardening exponent n =0.2, Determine the draw stress and draw force in this operation	10
Q3	a)	A billet of 20mm diameter and 50mm length is to be extruded in a direct extrusion method it has extrusion ratio of rx=4, The W/P has flow curve defined K = 415MPa, n= 0.18, Determine the pressure applied to the end of the billet (C=75,50,25) As the ram moves forward. Take a=0.8 and b =1.5 for Johnson equation	10
	b)	List out advantageous and disadvantageous of extrusion process	10
Q4	a)	A cylindrical work piece is subjected to cold upset forging operation. The starting piece is 100 mm in height and 60 mm in diameter. It is reduced in the operation to a height of 50 mm. The work material has a flow curve defined by Kf= 1 + (0.4μD/h), where Kf= forging shape factor, K=350 MPa and n=0.17. Assume a coefficient of friction of 0.1. Determine the force as the process begins, at the intermediate height of 62 mm and at the final height of 36 mm.	10
	b)	Explain the effect of temperature and strain rate on metal forming	10
Q5	a)	In a single pass rolling operation, a 25 mm thick plate with plate width of 100 mm, is reduced to 22 mm. The roller radius is 350 mm and rotational speed is 11 rpm. The average flow stress for the plate material is 300 MPa. Calculate the power required for the rolling operation in kW.	10
	b)	Explain operation and principle of Forging Process.	10

Q6 Answer any two 2x10=20

a) Effect of cold working on Mechanical Properties of the material.
b) Differentiate direct and indirect extrusion process.
c) Explain with sketches of drawing process and list out components in drawing process
d) Explain Forged products mechanical properties with sketches

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Duration : 3Hrs **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 standard steam table is permitted.**

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

a) Describe working of Double acting air compressor with the help of P-V diagram.

b) Describe working of Regenerative Gas Turbine cycle with the help of T-S diagram.

c) Illustrate working of Francis turbine.

d) Illustrate impulse momentum principle and reaction principle in Hydraulic turbines.

e) State the role of Steam stop valve, Economizer, Blow of cock, Air preheater and Water level indicator in Boiler.

Q. 2 a) At a stage in a reaction turbine, the mean blade ring diameter is 1 m. The turbine runs at 3000 rpm. The blades are designed for a degree of reaction of 50 % with exit angles of 30° and the inlet angles of 50°. The turbine is supplied with a steam at 10000 kg/hrs and the stage efficiency is 85 %. Calculate: **(10)**

i. Power output of the stage
ii. Specific enthalpy drops in kJ/kg
iii. The specific steam consumption.

b) Differentiate between Fire Tube and Water Tube boiler. **(05)**

c) Differentiate between Steam turbine and Gas turbine. **(05)**

Q. 3 a) The pressure ratio of an open cycle gas turbine power plant is 5.6. Air is taken at 30°C and 1 bar. The compression is carried out in two stages with perfect intercooling in between. Assuming the isentropic efficiency of each compressor stage as 85% and that of turbine as 90%, determine the power developed and efficiency of the power plant. If the air flow is 1.2 kg/sec. The mass of the fuel may be neglected, and assumed C_p = 1.02 kJ/kgK and γ = 1.41. **(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) Describe working of Turbojet Engine. **(05)**

Q. 4

a) The following reading were obtained during a boiler trial of 6 hours' duration: Mean steam pressure = 12 bar; mass of steam generated = 40000Kg; mean dryness fraction = 0.85; mean feed water temperature = 30°C; Coal used = 4000kg; Calorific value of coal = 33400 kJ/Kg. Determine Factor of equivalent evaporation, Equivalent evaporation from & at 100°C and Efficiency of the boiler. **(10)**

b) Define degree of reaction. Draw velocity triangle diagram for 50% reaction turbine **(05)**

c) Describe cavitation in pumps and state its drawbacks. **(05)**

Q. 5

a) The impeller of a centrifugal pump having external and internal diameters 500 mm and 250 mm respectively, width at outlet 50 mm and running at 1200 r.p.m. works against a head of 48 m. The velocity of flow through the impeller is constant and equal to 3 m/s. The vanes are set back at an angle of 40º at outlet. Determine: **(10)**

(i) Inlet vane angle,
(ii) Work done by the impeller on water per second, and
(iii) Manometric efficiency

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

c) Describe working of reciprocating pump with the help of neat sketch. **(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) Describe Pressure-velocity compounding of Impulse turbine **(06)**

c) Define priming and state it's importance **(04)**

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(3 Hours) **[Total Marks: 80]**

N.B. 1) **Question No. 1 is compulsory**
2) Solve **Any Three** from remaining **Five** questions.
3) Use of standard data book like PSG, Mahadevan is permitted
4) Assume suitable data if necessary, giving justification

Q1 Answer any **Four** from the following

a) Discuss the type of materials and properties of clutch plate lining. **5**
b) Explain the Chordal action of a chain drive. **5**
c) Write note on Design consideration of forging. **5**
d) Discuss about oil feeding and oil circulating methods in Journal bearings. **5**
e) Express the relation between shear stress and crushing stress for a square key equally strong in shear and crushing. **5**

Q2a) Screw jack has to lift a load of 90 KN through a height of 350 mm.
1) Select suitable material for screw and nut. **04**
2) Design screw and nut. **07**
3) Check screw for buckling failure. **04**

Q2b) Explain overhauling of screw and self-locking of screw. **05**

Q3a) A shaft is housed in the bearing 2.2 m apart. It carries a pulley of diameter 350 mm at 200 mm to the right of the left-hand bearing. It also carries another pulley of 550 mm diameter to a distance of 1000 mm to the left of right-hand bearing. 350 mm diameter pulley receives 25 KW power from a motor kept below it with the help of flat belt drive. 550 mm diameter pulley delivers power with the help of horizontal flat belt drive. The coefficient of friction and angle of contact for both the pulleys are 0.28 and 160^0. Design the solid shaft. Assume the weight of both the pulleys are 1.2 KN each and the shaft is made of C45. The assembly rotates with 440 rpm in clockwise direction when viewed from left to right. **15**

Q3b) Draw and explain different fatigue stress cycles. **05**

Q4a) A ball bearing mounted on a 90 mm shaft operates on the following work cycle. **10**

No.	Radial Load (KN)	Speed (rpm)	Duration in second
1	3	720	3
2	7	1440	4
3	5	900	3

Select a suitable bearing for a life of 10,000 hours with 93% probability of survival

Q4b) The load on a 75 × 75 mm 360^0 hydrodynamic bearing is 12.5 KN. Journal speed 2000 rpm and viscosity of oil 10 CP. Clearance ratio $\frac{1}{1000}$. Calculate. **10**

1) The minimum oil film thickness.
2) The coefficient of friction.
3) Power lost in friction.
4) The total oil flow rate.
5) Rise in temperature of bearing.

Q5a) Determine size of rubber canvas flat belt to transmit 5.5 KW power from an electric motor rotating at 960 rpm to an intermediate shaft of machine tool. The reduction ratio is 2.8 approximately and expected life is 1200 hours. **10**

Q5b) Calculate the factor of safety on breaking load for a chain 10A-2 DR50 which is used to transmit 15 KW design power. The input speed is 960 rpm and reduction ratio is 2.90. **10**

Q6a) A helical spring is subjected to the load varying from 500 N to 1100 N, having spring index of 6, free length of spring is to lie between 100 mm to 150 mm. The maximum compression under variation of load is 3 cm. Assuming stresses for spring material and G = 0.8×10^5 N/mm^2. Design the spring and find the energy stored in the spring. **15**

Q6b) State different theories of failure and explain any two in details. **05**

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

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.
(5) Use of Refrigerant tables, Friction charts, Psychometrics chart, and Steam table are permitted.

Qu.1 Attempt any Five of the following **[20]**

a) Define the i) Refrigeration ii) Ton of refrigeration iii) Air conditioning iv) Coefficient of performance
b) Explain difference between vapour compression refrigeration system and vapour absorption refrigeration system
c) Define the term 'by pass factor' Express it for heating and cooling coil.
d) State the various applications of HVACR and explain any one application
f) Classifiy of heat pump and its application in an industry
g) Define the effective temperature. What are physiological hazards resulting from heat?
h) Name the different types of air refrigeration system used for the cooling of the aircraft cabin. Draw bootstrap air refrigeration cycle with neat schematic

Qu.2 a) Draw a schematic diagram of vapour compression system. Discuss the effect of change in evaporator and condenser pressure on the performance of standard VCR cycle with the help of P-H diagram. **[08]**

b) An air refrigeration system used for food storage provides 25 tons of refrigeration. The temperature of air entering the compressor is 7°C and temperature at exit from the cooler is 27°C. The quantity of air circulated in the cooler is 3000 kg/hr. Both the compression and expansion follows the polytropic law $PV^{1.3} = C$. Calculate COP of the cycle and power required by the compressor per ton of refrigeration. **[12]**

Qu.3 a) Explain the types of refrigerants, numbering system for halocarbon refrigerants with example. **[08]**

b) A Simple NH_3 Vapor compression system has compressor with piston displacement of 3 m^3/ min, a condenser pressure of 12 bar and evaporator pressure of 2.5 bar. The liquid is subcooled to 20°C by soldering the liquid line to suction line. The temperature of vapour leaving the compressor is 100°C heat rejected to compressor cooling water is 6000 KJ/hr and volumetric efficiency of compressor is 0.8. 1) Find capacity of the system 2) Indicated power 3) COP of the system. Draw P-H and T-S Diagram. Use PH Chart. **[12]**

Qu.4 a) The pressure and temperature of mixture of dry air and water vapor in it are 736 mm of Hg and 21^{O}C. Calculate 1) Relative Humidity 2) Specific Humidity 3) Enthalpy 4) Specific Volume. Calculate using Steam Table. **[08]**

b) Explain the various methods of duct design. **[06]**

c) Discuss the Li-Bi vapour absorption system with neat sketch **[06]**

Qu.5 a) Explain following Psychrometric Processes with neat sketch. **[08]**
a) Heating & Humidification. b) Cooling & Dehumidification. c) Sensible Heating (d) Sensible Cooling

b) An air-conditioned auditorium is to be maintained at 27^{O}C dry bulb temperature and 60% relative humidity. The ambient condition is 40^{O}C dry bulb temperature and 30^{O}C wet bulb temperature. The total sensible heat load is 100000 KJ/hr. and total latent heat load is 40000 KJ/hr. 60% of the return air is recirculated and mixed with 40% of make up air after the cooling coil. The condition of air leaving the cooling coil is at 18^{O}C. Determine a) Room sensible heat factor **[12]**
b) The condition of air entering the auditorium c) The amount of makeup air
d) Apparatus dew point e) By pass factor of the cooling coil.

Qu.6 Write short note on (any Four) **[20]**
a) Deep sea water air-conditioning
b) Cooling towers performance and selection
c) Explain working of commercial ice plant
d) Working of thermostatic expansion valve
e) Types of fans used air conditioning
f) Type of insulation materials

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