

Mechanical Department
Bachelor Of Engineering
Question Papers May-June 2019
Sem III to VIII

S E (III) echoice Based) (MECH) 8th May 2019

(3hours)

[Total marks: 80]

- N.B.** 1) Question No. 1 is compulsory.
 2) Answer **any Three** from remaining
 3) Figures to the right indicate full marks

1. a) Find Laplace transform of $f(t) = t \int_0^t e^{-2u} \sin 4u \, du$. 5

b) Show that the set of functions $\sin nx, n = 1, 2, 3 \dots$ is orthogonal on $(0, 2\pi)$. 5

c) Calculate Spearman's rank correlation coefficient R , from the given data, 5

X: 12, 17, 22, 27, 32.

Y: 113, 119, 117, 115, 121

d) Find the constants a, b, c, d, e if

$f(z) = ax^3 + bxy^2 + 3x^2 + cy^2 + x + i(dx^2y - 2y^3 + exy + y)$
 is analytic. 5

2. a) Find Laplace transform of the periodic function, defined as

$$f(t) = \begin{cases} t, & 0 < t < 1 \\ 0, & 1 < t < 2 \end{cases} \text{ and } f(t+2) = f(t) \text{ for } t > 0 \quad 6$$

b) If $v = 3x^2y + 6xy - y^3$, show that v is harmonic and find the corresponding analytic function $f(z) = u + iv$. 6

c) Obtain Fourier series of $f(x) = x^2$ in $(0, 2\pi)$. Hence, deduce that – 8

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$$

3. a) Using convolution theorem, find the inverse Laplace transform of 6

$$F(s) = \frac{1}{s^2(s+5)^2}$$

b) Solve $\frac{\partial^2 u}{\partial x^2} - 16 \frac{\partial u}{\partial t} = 0$, subject to the conditions,
 $u(0, t) = 0, u(1, t) = 3t, u(x, 0) = 0, 0 \leq x \leq 1$, taking $h = 0.25$
 up to 3 seconds only by using Bender-Schmidt method. 6

c) Using Residue theorem, evaluate,

$$\text{i) } \int_0^{2\pi} \frac{d\theta}{17-8\cos\theta} \quad \text{ii) } \int_0^\infty \frac{dx}{(x^2+1)^2} \quad 8$$

[TURN OVER]

4. a) Solve by Crank –Nicholson simplified formula $\frac{\partial^2 u}{\partial x^2} - \frac{\partial u}{\partial t} = 0$,

$u(0, t) = 0, u(1, t) = 0, u(x, 0) = 100(x - x^2)$, with $h = 0.25$ for one-time step. 6

- b) Evaluate $\int_C \frac{z}{(z-2)(z+1)^2} dz$, $C: |z| = 3$. 6

- c) Solve $(D^2 - 2D + 1)y = e^{-t}$ with $y(0) = 2, y'(0) = -1$ where $D \equiv \frac{d}{dt}$ 8

5. a) Obtain all possible Taylor's and Laurent series which represent the function

$f(z) = \frac{z}{z^2 - 5z + 6}$ indicating the region of convergence. 6

- b) Evaluate $\int_0^\infty te^t \cos^2 t dt$ 6

- c) Obtain half range Fourier cosine series of $f(x) = x(\pi - x), 0 < x < \pi$.
Using Parseval's identity, deduce that – 8

$$\frac{\pi^4}{90} = \frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} + \dots$$

6. a) Find the image of the circle $|z| = 2$ under the transformation $w = z + 3 + 2i$.
Draw the sketch. 6

- b) A rectangular metal plate with insulated surfaces of width l and so long as compared to its breadth that it can be considered infinite in length without introducing an appreciable error. If the temperature along one short edge $y = 0$ is given by $u(x, 0) = u_0 \sin\left(\frac{\pi x}{l}\right)$ for $0 < x < l$ and other long edges $x = 0$ and $x = l$ and the short edges are kept at zero degrees temperature, find the function $u(x, y)$ describing the steady state, assuming that in the steady state the heat distribution function $u(x, y)$ satisfies the Laplace equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$. 6

- c) Production (in metric kiloton) of wheat in a country is given by the following data,

Year (x)	2005	2007	2009	2011	2013	2015	2017
Production (y)	8	12	15	19	21	22	25

Fit a straight line to the data and estimate the production in the year 2010. 8

14/05/19.

S.E. (MECH) CBCGS (Choice Base) III Semester
Time: 3 Hours

Q. P. Code: 39994

Total Marks: 80

- N. B. : (1) Question No. 1 is compulsory.
 (2) Solve any **three** out of the remaining **five** questions.
 (3) Assume suitable data if required and state it clearly.
 (4) Use of Steam Table and Mollier diagram is permitted

- 1 Attempt any **four** out of the following 20
 (a) What is the difference between a closed and an open system
 (b) Define Mech. Efficiency in case of reciprocating air compressor and state the methods used to improve isothermal efficiency?
 (c) Define: available energy, dead state and irreversibility
 (d) Draw a simple schematic diagram of a thermal power plant with one reheater. Also represent this on T-S diagram
 (e) Write four Maxwell relations.
- 2 (a) A fluid system contained in a piston cylinder machine, passes through a complete cycle of four processes. The sum of all heat transfer during the cycle is -170 KJ. The system completes 100 cycles/min. Complete the following table showing the method for each process and compute the net rate of work output in KW. 12

Process	Q(KJ/min)	W(KJ/min)	$\Delta E(KJ/min)$
1-2	0	2170	----
2-3	21000	0	----
3-4	-2100	----	-36600
4-1	----	----	----

- (b) Derive and show that the efficiency of Brayton cycle depends on the pressure ratio. 8
- 3 (a) Air enters a compressor operating at steady state at a pressure of 1 bar, a temperature of 290 K and a velocity of 6 m/s through an inlet with an area of 0.1 m². At exit the pressure is 7 bar, the temperature is 450 K and the velocity is 2 m/s. Heat transfer from the compressor to the surroundings occur at the rate of 180 kJ/min. Employing the ideal gas model, calculate the power input to the compressor. 10
- (b) Calculate the decrease in exergy when 25 kg of water at 95°C mix with 35 kg of water at 35°C, the pressure being taken as constant and the temperature of surroundings being 15°C. 10
- 4 (a) Explain the Carnot heat engine cycle executed by a) a stationary system and b) a steady flow system. 8

- (b) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source, while engine B is in communication with a cold sink at a temperature of 4.4°C . If the work output of A is twice that of B, find a) intermediate temperature between A and B b) efficiency of each engine and c) the heat rejected to the cold sink. 12
- 5 (a) In an I.C. engine operating on the dual cycle, the temperature of the working fluid (air) at the beginning of the compression is 27°C . The ratio of the maximum and minimum pressures of the cycle is 70 and compression ratio is 15. The amounts of heat added at constant volume and constant pressure are equal. Compute the air standard thermal efficiency of the cycle. 10
- (b) Air initially occupying 1 m^3 at 1.5 bar, 20°C undergoes an internally reversible compression for which $PV^n = \text{constant}$ to a final state where the pressure is 6 bar and temperature is 120°C . Determine i) the value of n ii) the work and heat transfer iii) change in entropy 10
- 6 (a) In a Rankine cycle the steam at the inlet to the turbine is at 100 bar and 500°C . If the exhaust pressure is 0.5 bar, determine the pump work, turbine work, condenser heat flow and Rankine efficiency. 10
- (b) What is meant by complete and perfect intercooling in case of multistage air compressor? What is the effect of multi staging over the volumetric efficiency of reciprocating air compressor? 10

3 Hours

Total Marks: 80

- Question-1 is compulsory.
- Answer any three from remaining five questions.
- Assume any suitable data wherever required but justify the same. Assumptions made should be clearly stated.
- Illustrate answers with sketches wherever required.

I Answer any four of the following:

Ia. A material has Young's Modulus of $2 \times 10^5 \text{ N/mm}^2$ and Poisson's Ratio of 0.32. Calculate the Modulus of Rigidity and Bulk Modulus of the material. 05

Ib. Derive the relationship between the rate of loading, shear force and bending moment in a beam. 05

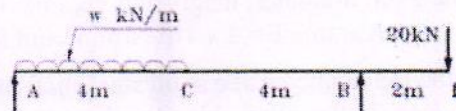
Ic. A simply supported beam of span 4 m with EI constant throughout the span is subjected to a load of 24 kN at 3 m from left end support. Find total strain energy of the beam in bending. 05

Id. State the assumptions made in the theory of pure bending and derive the formula, 05

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

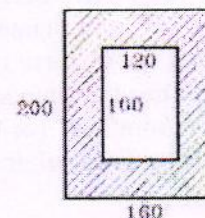
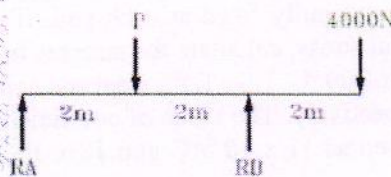
Ie. A short column of external diameter 400 mm and internal diameter 200 mm carries an eccentric load of 90 kN. Find the greatest eccentricity, which the load can have without producing tension on the cross section. 05

IIa. For a beam loaded as shown in figure, calculate the value for UDL, w so that bending moment at C is 50 kNm. Draw the shear force and bending moment diagrams for the beam for the calculated value of w. Locate the point of contra flexure, if any. 12

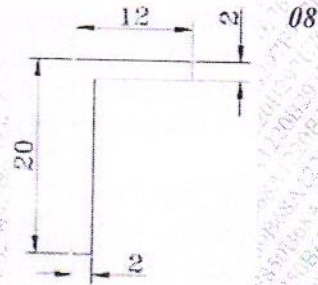


IIb. An elemental cube is subjected to tensile stresses of 30 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress. 08

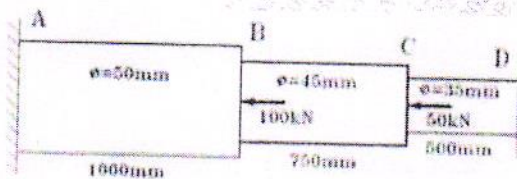
IIIa. A box beam supports the loads as shown in figure. Compute the maximum value of P that will not exceed bending stress $\sigma = 8 \text{ MPa}$ or shear stress $\tau = 1.2 \text{ MPa}$ for section between the supports. Also, draw the shear stress distribution diagram at a section where shear force is maximum. 12



- IIIb. Find the principal moments of inertia and directions of principal axes for the angle section shown. All dimensions are in cm.



- IVa. A stepped round bar ABCD is fixed to unyielding support at sections A & D as shown in figure. It is subjected to axial loads at sections B and C. Determine stresses in each portion of the bar and deflections of sections B and C. Take $E = 200 \text{ GN/m}^2$

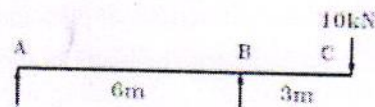


- IVb. A cylindrical vessel of 1.5 m diameter and 4 m long is closed at ends by rigid plate. It is subjected to an internal pressure of 3 N/mm^2 . If maximum circumferential stress is not to exceed 150 N/mm^2 , find the thickness of the shell. Find change in diameter, length and volume of the shell.

Assume $E = 2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.25.

- Va. Determine the diameter of a solid steel shaft that will transmit 150 kW at a speed of 3 rev/sec, if the allowable shearing stress is 85 MPa. Also, determine the diameter of a hollow steel shaft, whose inside diameter is $\frac{3}{4}$ th of its outside diameter for the same conditions. What is the ratio of angle of twist per unit length for these two shafts?

- Vb. An overhanging beam ABC is loaded as shown in figure. Find the slopes over each support and the deflection at the right end. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $I = 5 \times 10^8 \text{ mm}^4$



- VIa. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly fixed at each end. If at a temperature of 10°C , there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C . Take E for steel and copper as $2.1 \times 10^5 \text{ N/mm}^2$ and $1 \times 10^5 \text{ N/mm}^2$ respectively. The value of coefficient of linear expansion for steel and copper is given as $11 \times 10^{-6}/^\circ\text{C}$ and $18 \times 10^{-6}/^\circ\text{C}$ respectively.

- VIb. From the following data, determine the thickness of cast iron column. Assume both the ends of the column are fixed.

Length of the column = 3 m
External diameter = 200 mm
Safe working load = 600 kN

Factor of Safety = 5
Ultimate compressive stress = 570 N/mm^2
Rankine constant = $1/1600$

Time: 3 Hours

Max Marks: 80

Instructions:

1. Question no. 1 is compulsory.
2. Answer any three questions of the remaining five questions.
3. Make suitable assumptions wherever necessary.
4. Figures to the right indicate full marks.

Q.1. Attempt the following two questions: (10 marks each).

- a. Classify Production Processes in detail. 10
- b. Compare wood and metal as pattern materials. 10

Q.2. Attempt the following two questions: (10 marks each).

- a. Describe the CO₂ Shell Moulding Process. 10
- b. Differentiate between MIG welding and TIG welding. 10

Q.3. Attempt the following two questions: (10 marks each).

- a. Describe Rolling process in general with a neat labeled sketch. 10
- b. Compare Drop Forging with Hammer Forging process. 10

Q.4. Attempt the following two questions: (10 marks each).

- a. Describe the Blow Moulding process for plastics. 10
- b. Describe Reaction Moulding of polymers with a neat labeled sketch. 10

Q.5. Attempt the following two questions: (10 marks each).

- a. How does a Gear Cutting process differ from a Gear Generating process? 10
- b. How can a lathe machine be specified for the purpose of purchasing? 10

Q.6. Attempt the following two questions: (10 marks each).

- a. What is meant by a 'Closed Loop Control System' and an 'Open Loop Control System'? 10
- b. What is a Transfer Line Machine? Draw a neat labeled sketch. 10

SE (MECH) Sem-III (choice base)

30/5/2019

Time: 3 hours

Marks: 80

- N. B. 1) Question No.1 is compulsory.
 2) Attempt any three questions from remaining five questions.
 3) Figures at right indicate marks.

- Q. 1 Write notes on any four:- (20)
- Explain thermal fatigue of metal.
 - What are smart materials? Where are they used?
 - Write the difference between ductile fracture and brittle fracture.
 - Explain Hume-Rothery's rules of solid solubility.
 - Explain the transformation of austenite to Bainite.
- Q. 2 a) What is dislocation? What are the sources of dislocation? Compare edge and screw dislocation. (10)
- b) What is recrystallization annealing? Discuss the various stages of recrystallization annealing. (05)
- c) Write the difference hot working and cold working. (05)
- Q. 3 a) What are the characteristics of brittle fracture? Discuss Griffith's theory and derive its equation. (10)
- b) Discuss ductile-brittle transition in steel. (05)
- c) Define creep and explain stages of creep. (05)
- Q. 4 a) Draw Fe-Fe₃C diagram indicating all important temperatures, phases and compositions. Explain slow cooling of an alloy containing 0.9% carbon when cooled from 1600°C temperature to room temperature. (10)
- b) Write short note on allotropic forms iron. (05)
- c) Draw and explain Isomorphous phase diagram. (05)
- Q. 5 Write short notes on following : (20)
- Nano-materials
 - Discuss the process of nitriding.
 - What are composites? Write its characteristics
 - Explain the effect of retained austenite on steels.
 - What are stainless steels? Give brief of classification of stainless steels
- Q. 6 a) Draw TTT curve for a eutectoid steel and explain the effects of various cooling curves on transformation products (10)
- b) Write the classification of tool steels (05)
- c) Explain induction hardening process (05)

SE (IV) (CBCS) (MECH) 7th May 2019

Choice Based

Duration – 3 Hours

Total Marks : 80

N.B.:- 1. Question no 1 is compulsory.

2. Attempt any THREE questions out of remaining FIVE questions.

Q.1 a) Write the dual of the given LPP

Maximize $Z = 4x_1 + 9x_2 + 2x_3$

Subject to: $2x_1 + 3x_2 + 2x_3 \leq 7$, $3x_1 - 2x_2 + 4x_3 = 5$, $x_1, x_2, x_3 \geq 0$. (5)

b) If X is a Random Variable with probability density function (5)

$$f(x) = \begin{cases} kx; 0 \leq x \leq 2 \\ 2k; 2 \leq x \leq 4 \\ 6k - kx; 4 \leq x \leq 6 \end{cases}$$

Find k, expectation and $P(1 \leq x \leq 3)$.

c) A tyre company claims that the life of the tyres have mean 42,000 kms with standard deviation of 4,000 kms. A change in the production process is believed to a result in better product. A test sample of 81 new tyres has a mean life 42,500 kms. Test at 5% level of significance that the new product is significantly better than the old one. (5)

d) Find the minimal polynomial of $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. Is A derogatory? (5)

Q.2 a) Use Big-M method to solve the following LPP (6)

Minimize $Z = 2x_1 + x_2$

subject to $3x_1 + x_2 = 3$,

$4x_1 + 3x_2 \geq 6$,

$x_1 + 2x_2 \leq 3$, $x_1, x_2 \geq 0$

b) Find e^A and 4^A if $A = \begin{bmatrix} 3/2 & 1/2 \\ 1/2 & 3/2 \end{bmatrix}$. (6)

c) Verify Green's theorem for $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the closed curve given by $y = x^2$, $y = \sqrt{x}$. (8)

Q.3 a) Prove that $\vec{F} = 2xyz^2\mathbf{i} + (x^2z^2 + z \cos yz)\mathbf{j} + (2x^2yz + y \cos yz)\mathbf{k}$ is a conservative field. Find ϕ such that $\vec{F} = \nabla\phi$. Hence find the work done in moving an object in this field from $(0,0,1)$ to $(1, \frac{\pi}{4}, 2)$. (6)

b) The standard deviations calculated from two random samples of sizes 9 and 13 are 1.99 and 1.9. Can the samples be regarded as drawn from the normal populations with same standard Deviations. (6)

(Given: $F(0.025) = 3.51$ with d. f. 8 & 12 and $F(0.025) = 4.20$ with d. f. 12 & 8.)

- c) Find the index, rank, signature and class of the Quadratic Form $x_1^2 + 2x_2^2 + 3x_3^2 + 2x_1x_2 - 2x_1x_3 + 2x_2x_3$ by reducing it to canonical form using congruent transformation method. (8)

Q. 4 a) Evaluate $\iint_S \vec{F} \cdot d\vec{S}$ where $\vec{F} = (2xy + z)i + y^2j - (x + 3y)k$ and S is the closed surface bounded by $x = 0, y = 0, z = 0, 2x + 2y + z = 6$. (6)

- b) Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$ and hence find $2A^4 - 5A^3 - 7A + 6I$. (6)

- c) A sample of 400 students of under-graduate and 400 students of post-graduate classes was taken to know their opinion about autonomous colleges. 290 of the under-graduate and 310 of the post-graduate students favoured the autonomous status. Use chi-square test and test that the opinion regarding autonomous status of colleges is independent of the level of classes of students. (8)

Q. 5 a) Prove that $\nabla \times \left[\frac{\vec{a} \times \vec{r}}{r^3} \right] = \frac{-\vec{a}}{r^3} + \frac{3(\vec{a} \cdot \vec{r})\vec{r}}{r^5}$ (6)

- b) Show that the matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 3 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ is diagonalizable and hence find the transforming matrix and diagonal matrix. (6)

- c) Ten school boys were given a test in statistics and their scores were recorded. They were given a month special coaching and a second test was given to them in the same subject at the end of the coaching period. Test at 5% level of significance, if the marks given below give evidence to the fact that the students are benefited by coaching. (8)

Mark in test 1: 70 68 56 75 80 90 68 75 56 58

Mark in test 2: 68 70 52 73 75 78 80 92 54 55

Q. 6 a) In a sample of 1000 cases, the mean of a certain test is 14 and Standard Deviation is 2.5. Assuming the distribution to be normal, find (6)

- 1] how many students score between 12 & 15.
2] how many score above 18.

- b) Evaluate by Stoke's theorem $\int_C xy dx + xy^2 dy$, where C is the square in the xy -plane with vertices $(1, 0), (0, 1), (-1, 0), (0, -1)$. (6)

- c) Using duality solve the following L.P.P. (8)

Minimise $z = 0.7x_1 + 0.5x_2$

subject to $x_1 \geq 4, x_2 \geq 6, x_1 + 2x_2 \geq 20, 2x_1 + x_2 \geq 18,$

$x_1, x_2, x_3 \geq 0.$

Date: 13/05/19.

B.E. MECH (Choice Base), Sem IV,

[3 Hours]

[Marks: 80]

N.B Question no.1 is compulsory.
Attempt any **THREE** from question no.2 to 6.
Use illustrative diagrams wherever possible.

Q.1 Attempt any four from the following. Each question carry equal marks.

20

- a) Explain conditions of equilibrium of floating bodies
- b) Explain i) velocity potential function ii) stream function
- c) Do the following velocity component represent physically possible flow?

$$u = x^2y \quad ; \quad v = 2zy - xy^2 \quad ; \quad w = x^2 - z^2y$$

- d) An aircraft is flying with a velocity of 200 m/s through the still air at -15°C . Find the stagnation pressure, if the mass density of the air is 1.08 kg/m^3 . Take pressure of the air as 80 kPa. Take $R = 287 \text{ J/kgK}$.
- e) Explain surface tension and capillarity

Q.2

10

- a) A heavy car plunges into a lake during an accident and lands at the bottom of the lake on its wheels. The door is 1.2 m high and 1 m wide, the top edge of the door is 8 m below the free surface of the water. Determine the hydrostatic force acting on the door approximating it as a vertical rectangular plate and the location of centre of pressure considering bottom of the lake surface as horizontal.

- b) What is Venturimeter? Derive expression of the discharge through venturimeter. 10

Q.3

10

- a) A 45° reducing bend is connected in a pipe line, the diameter at the inlet and outlet of the bend being 400 mm and 200 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet of bend is 215.8 kN/m^2 . The rate of flow of water is 500 lit/sec.

10

- b) A fluid of viscosity 8 poise and specific gravity 1.2 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is 210 N/m^2 . Find i) The pressure gradient ii) The average velocity iii) Reynolds number of flow.

Q.4

10

- a) Two reservoirs with a difference in elevation of 15 m are connected by two pipes in series. The pipes are 150 m long of 20 cm diameter and 200 m long of 25 cm diameter respectively. The friction factors for the two pipes are respectively 0.020 and 0.019. Determine discharge through pipe considering both major and minor losses.

07

- b) What do you mean by boundary layer separation? What is the effect of pressure gradient on boundary layer separation?

- c) Define Mach number and give its significance.

03

Q.5

- a) Describe compressible flow through a convergent-divergent nozzle.

07

- b) What do you understand by displacement thickness and momentum thickness?

08

Determine displacement thickness and momentum thickness for the following velocity distribution.

$$\frac{u}{U_0} = \frac{3}{2} \left(\frac{y}{\delta} \right)$$

05

- c) A flow field is characterised by $\psi = x^3y$. Determine the velocity potential function ϕ for the flow if the flow is irrotational.

Q.6

05

- a) An aeroplane is flying at a height of 20 km, where the temperature is -40°C . The speed of the plane is corresponding to $M = 1.8$. Assuming $k = 1.4$ and $R = 287 \text{ J/kgK}$. Find the speed of the plane.

- b) Explain streamlined body and bluff body.

05

- c) State and prove Bernoulli's theorem for streamline flow.

10

17/5/2019

SE (Mech) / Sem -IV / choice based

Duration -Three Hrs.

Total Marks-80

N. B. 1. Question No. 1 is compulsory

2. Solve any three questions out of remaining five questions

3. Figures to the right indicate full marks

Q. 1 Attempt Any four of the followings

A Draw and explain V-I characteristics of SCR 5

B Explain the need of freewheeling diode in controlled rectifier with R-L load. 5

C Draw and explain equivalent circuit of an OP-Amp. 5

D Differentiate Between Multiplexer and De-multiplexer. 5

E Compare between DC Motor and AC Motor. 5

Q.2 A Draw and explain functional block diagram of timer IC 555. 7

B Draw and explain fan regulator circuit using TRIAC and DIAC. Draw Waveforms. 7

C State and prove Demorgan's theorems in Boolean Algebra. 6

Q.3 A Draw and explain semi-controlled rectifier. Draw waveforms. 7

B Draw and explain MSP430 architecture. 7

C Draw and explain Instrumentation amplifier State its advantages and disadvantages. 6

Q.4 A Draw and explain BLDC motor. State its advantages. 7

B State and Define specification parameters of Digital logic family. 7

C Explain construction and characteristics of Power BJT 6

Q.5 A With the help of connection diagram, derive the relation for voltage gain in inverting mode of operation of operational amplifier. 7

B With the help of circuit diagram and waveforms, explain the generation of output voltage in three phase inverter in 180° conduction mode of operation. 7

C What do you understand by servo motor. State its applications. 6

Q.6 A Draw and explain slip-torque characteristics of three phase AC motor. 7

B Draw and explain CMOS NAND gate with the help of truth table. 7

C Differentiate between microprocessor and Microcontroller. 6

(3 Hours)

[Total Marks : 80]

N.B. (1) Question no. 1 is compulsory.

(2) Attempt any **three** questions out of remaining **five** questions.(3) **Illustrate** your answer with **necessary** sketch wherever **necessary**.(4) **Figures** to the **right** indicate full **marks**.(5) **Assume** suitable data wherever **necessary**.1. Attempt any **FOUR** of the following :

(20)

- (a) How does Additive Manufacturing differ from CNC machining?
- (b) What is the difference between traditional and non-traditional machining processes?
- (c) What is meant by grit, grade and structure of a grinding wheel?
- (d) Differentiate between a compound die and combination die.
- (e) What is meant by chip thickness ratio? What does it depend on? Draw a neat labelled sketch to show various angles and velocities related to chip thickness ratio.

2. (a) What are the factors determining the material removal rate in Electric Discharge Machining Process. Elaborate on them. (10)

(b) Differentiate between Orthogonal and Oblique cutting. (10)

3. (a) Differentiate between blanking and punching process with a neat labelled sketch. (10)

(b) What is meant by locating, Clamping and resting w.r.t. Jigs and Fixtures. (10)

4. (a) What is meant by a cutting tool signature? How do you express it in ORS and NRS system. Draw a neat labelled sketch to show it in the two systems along with the nomenclature. (10)

(b) Describe the process of photo-polymerization with a neat labelled sketch. (10)

5. (a) What are the parameters governing Photo-polymerization process? (10)

(b) What is meant by Tool Life Equation? How is it useful? (10)

6. Write short notes on: (20)

- (a) Geometry of a broach.
- (b) Laser Beam Machining
- (c) Types of dynamometers used in machine tools.
- (d) Use of locators in designing jigs and fixtures.
- (e) Requirements of a Milling Fixture.

Time: 3 Hrs

[Total Marks 80]

N.B.:

- (1) Question No.1 is compulsory
- (2) Attempt any three questions out of remaining five questions
- (3) Figures to right indicate full marks
- (4) Assume suitable data if necessary.
- (5) Notations carry usual meaning.

Q.1 Attempt any four

- A. State and prove Kennedy's Theorem
- B. Define i) Kinematic link ii) Kinematic pair iii) Kinematic chain.
- C. Classify follower in details.
- D. Explain self energizing and self locking brake.
- E. Explain the terms slip and creep in belts.
- F. State i) Work energy principle ii) D'Alemberts principle

20

- Q.2A. The mechanism, as shown in Fig. 1, the slider D is constrained to move on a horizontal path. The crank OA is rotating in the counter-clockwise direction at a speed of 180 r.p.m. The dimensions of various links are as follows : OA = 180 mm ; CB = 240 mm ; AB = 360 mm ; and BD = 540 mm. For the given configuration, find : 1. Velocity of slider D, 2. Angular velocity of links AB, CB and BD
1. By instantaneous centre method
 2. By relative velocity method

12

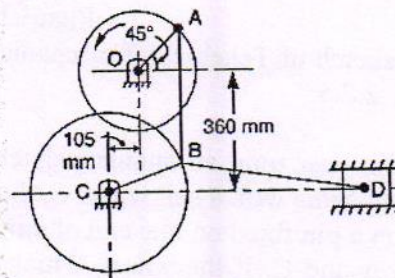


Figure No.1

- B. An open belt drive transmit power from a 300 mm diameter pulley running at 240 rpm to a pulley 450 mm diameter. Angle of lap on smaller pulley is 165° . The belt is on the point of slipping when 3KW is being transmitted. The coefficient of friction is 0.3. Determine effect on power transmission in following cases.
- i) Initial tension in the belt increased by 10%
 - ii) Suitable dressing is given to the belt surface to increase the coefficient of friction by 10%. Assume that initial tension is kept same.

08

- Q.3A. Two 20° involute spur gear have a module of 10mm. The addendum is one module. The larger has 50 teeth and the pinion has 13 teeth. Does interference occur? If it occur, to what value the pressure angle be changed to eliminate interference. 10
- B. Differentiate between involute and cycloidal gear tooth profile. 04
- C. In a crank and slotted lever quick return mechanism the distance between the fixed centres is 350 mm and length of driving crank is 150 mm. Find the inclination of slotted lever with vertical in the extreme position and ratio of time of cutting stroke to return stroke. 06
- Q.4 A. A mechanism of a crank and slotted lever quick return motion is shown in Figure 2. If the crank rotates counter clockwise at 120 r.p.m., determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Crank, $AB = 150$ mm ; Slotted arm, $OC = 700$ mm and link $CD = 200$ mm. 14

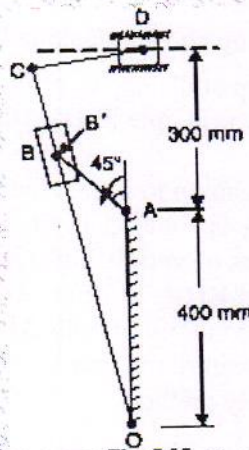


Figure No. 2

- B. Draw a neat sketch of Tchebicheff mechanism & prove that the length of link must be in a ratio of 1:2:2.5. 06
- Q.5A. In an epicyclic gear train an annular wheel A having 54 teeth meshes with a planet wheel B which gears with a sun wheel C, the wheel A and C being co-axial. The wheel B is carried on a pin fixed on one end of arm P which rotates at 100 rpm about the axis of the wheel A and C. If the wheel A makes 20 rpm in clockwise sense and the arm rotates at 100 rpm in anti clockwise direction and C has 24 teeth, Sketch the arrangement and determine rpm and sense of rotation of wheel C 08
- B. A cord wrapped around a solid cylinder of radius 'r' and mass 'm'. The cylinder is released from rest. Determine the velocity of its centre of mass after it has moved down a distance 'h'. 06
- C. Two shafts are connected by Hooke's joint. The driving shaft rotates at a uniform speed of 1000 rpm. The angle between the shafts is 20° . Calculate the maximum and minimum speed of driven shafts, when acceleration of the driven shaft is maximum. 06

- Q.6A. The centre to centre distance between the two sprocket of a chain drive is 600mm. The chain drive is used to reduce speed from 180 rpm to 90 rpm on driving sprocket has 18 teeth and a pitch circle diameter of 480 mm determine i) Number of teeth on driven sprocket ii) Pitch and length of chain 08
- B. A cam is rotating at 200 rpm operate a reciprocating roller follower of radius 2.5 cm. The least radius of cam is 30mm, stroke of follower is 5cm. Ascent takes place by uniform acceleration and deceleration and descent by simple harmonic motion. Ascent take place by 70° and descent during 50° of cam rotation. Dwell between ascent and descent 60° . Sketch displacement, velocity, acceleration and jerk diagram. 12

TE (MECH) (V) (choice based) 9th May 2019

(3 Hours)

[Total Marks: 80]

- N.B. 1) Question No. 1 is compulsory
2) Solve **Any Three** from remaining **Five** questions.
3) Assume suitable data if necessary and state it clearly.

Q1 Answer any **Four** from the following

- a) Write a short note on HCCI Engine. 05
- b) Give a brief account of Exhaust Oxygen Sensor 05
- c) Briefly discuss the various efficiency and their significance associated with Engine 05
- d) Compare Air Cooling System and Liquid Cooling System. 05
- e) Explain why a rich mixture is required for Idling and sudden acceleration. 05

- Q.2
- a) State the reasons for efficiency of actual cycle is much lower than the air standard cycle efficiency? List the major losses and differences in actual engine cycle and air standard cycle. Also draw actual cycle. 10
 - b) Explain the working of Transistorized Coil Ignition System with the help of neat Sketch and state its merits and Demerits. 10

- Q.3
- a) What are the essential properties of Lubricants? Explain with neat sketch Mist Lubrication System. 10
 - b) Calculate the diameter of fuel orifice of 4 stroke engine which develops 25 kW per cylinder at 2500 rpm. The specific fuel consumption is 0.3 kg/kW h and fuel is injected at a pressure of 150 bar over a crank travel of 25° . The pressure in the combustion chamber is 40 bar. Coefficient of velocity is 0.875 and specific gravity is 0.8762. 10

TURN OVER

- Q.4 a) A 4 stroke diesel engine working at sea level (pressure = 1 bar and temperature 17°C) develops a brake power of 280 kW with a volumetric efficiency of 80% at sea level condition. Engine works at an Air-Fuel ratio of 18:1, with specific fuel consumption of 0.240 kg/kW h. The engine runs at 1800rpm. Determine the engine capacity and the bmep. The Engine is taken to an altitude of 3 km where the ambient pressure and temperature are -23°C and 0.715 bar. A mechanically coupled supercharger is fitted which consumes 12% of the total power developed. The temperature of air leaving the supercharger is 37°C. Determine degree of supercharging required to maintain the same brake power of sea level. 12
- b) Describe the CRDI System with neat sketch and state its advantages and disadvantages 08
- Q.5 a) A test on a single-cylinder, 4 stroke oil engine having a bore of 15 cm and stroke 30 cm gave the following results: speed 300 rpm; brake torque 200 Nm; Indicated mean effective pressure 7 bar; fuel consumption 2.4 kg/h; cooling water flow 5 kg/min; cooling water temperature rise 35°C; air-fuel ratio 22; exhaust gas temperature 410°C; barometer pressure 1 bar; room temperature 20°C. The fuel has a calorific value of 42 MJ/kg and contains 15% by weight of hydrogen. Take latent heat of vaporization as 2250 kJ/kg. Determine the Indicated thermal Efficiency and volumetric efficiency based on atmospheric conditions. Also draw up a heat balance sheet in terms of kJ/min. Take C_p for dry exhaust gas as 1 kJ/kg-k and superheated steam $C_p = 2.1$ kJ/kg-k; $R = 0.287$ kJ/kg K 12
- b) Describe in detail the various stages of combustion in SI Engine 08
- Q.6 a) What is compensation and why it is done in Carburetor 05
- b) Write a note on ratings of fuel for IC Engine 05
- c) With a help of neat sketch explain Catalytic convertor 05
- d) Explain the working of Thermostatic Cooling system 05

T.E (MECH) Sem V CBCGS (Choice Base)

(3 Hours)

[Total marks: 80]

Instructions:

1. Question 1 compulsory.
2. Attempt any **three** questions from the remaining **five** questions.
3. Assume suitable data, **if necessary**.
4. **Figures/sketches** carry weightage.

- Q1) a) Determine the stability using Routh Hurwitz Criterion of the following characteristic equation: 05

$$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$$

- b) Differentiate between open and closed loop systems with their respective block diagrams and examples 05

- c) Explain the following terms with respect to static characteristics of the measuring instruments: 05

I) Hysteresis II) Accuracy and Precision III) Resolution IV) Drift

- d) Explain the principle of LVDT with a neat sketch 05

- Q2) a) Convert the following state space system into a transfer function 10

$$\dot{X}(t) = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -2 & -5 \end{pmatrix} X(t) + \begin{pmatrix} 0 \\ 0 \\ 10 \end{pmatrix} u(t)$$

$$Y(t) = [1 \ 0 \ 0] X(t)$$

Here $x(t)$ are state variables, $u(t)$ is a force vector and $y(t)$ being the system response

- b) Explain the construction and working of an Optical Pyrometer with a neat sketch 10

- Q3) a) A rectangular steel rod of width 'b' and depth 'd' is supported at its end and is loaded at its center by load 'W'. If the length of the rod between supports is 'l' and 'd_m' where - 12

$$d_m = \frac{Wl^2}{4Ebd^3}$$

Where;

$$b = 4.942 \pm 0.42 \text{ cm ;}$$

$$d = 5.25 \pm 0.25 \text{ cm ;}$$

$$l = 1000 \pm 0.5 \text{ cm,}$$

$$d_m = 2.622 \pm 2.25\%$$

$$W = 1500 \text{ N.}$$

Find value of modulus of elasticity, % of uncertainty in various quantities, % of uncertainty in various quantities.

- b) For a unity feedback system having open loop transfer function, 08

$$G(s) = \frac{14(s+3)}{s(s+5)(s^2+2s+2)}$$

Determine (i) Type and order of the system (ii) All error coefficients

$$(iii) \text{ Steady state error for input } 1 + 4t + \frac{t^2}{2}$$

- Q4) a) Prove Gauge factor, $K = \frac{\Delta \rho / \rho}{\Delta L / L} + 1 + 2\nu$ 10

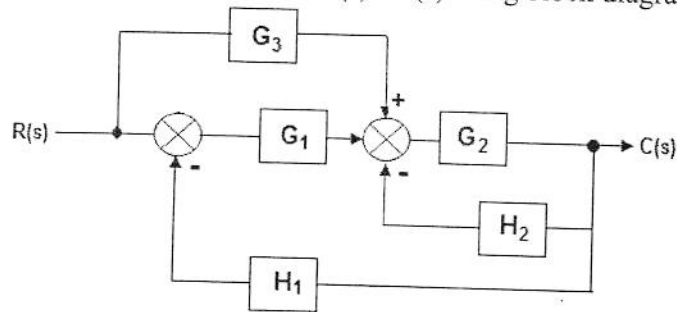
- b) Enumerate the types of pressure measurement devices w.r.t. to pressure levels. Explain the construction and working of Bourdon tube with a neat sketch 10

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TURN OVER

- Q5) a) Obtain transfer function $C(s) / R(s)$ using block diagram reduction technique.

10



- b) A feedback system has $G(s) H(s) = 242 (s+5) / s (s^2 + 5s + 121) (s+1)$. Draw Bode plot and comment on its stability. 10
- Q6) a) Sketch the Root Locus for the given system having $G(s) \cdot H(s) = K(s+5) / (s^2 + 4s + 20)$. Comment on its stability. 10
- b) Explain the construction and working of non contact type of speed measurement system with a neat sketch. 10

TE (Mech) / sem-V / Choice Based

Duration: 3 Hours

Max Marks: 80

Note:

- Question no.1 is compulsory.
- Attempt any **THREE** from question no. 2 to 6.
- Assume suitable data whenever necessary.

Q1) Solve any **Four**

20

- A refrigerator stands in a room where the air temperature is 30°C . The surface temperature on the outside of the refrigerator is 25°C . The sides are 30 mm thick and have an equivalent thermal conductivity of 0.1 W/m K . The heat transfer coefficient on the outside is $10 \text{ W/m}^2\text{K}$. Assuming one dimensional conduction through the sides, calculate the net heat flow per m^2 and the surface temperature on the inside.
- Define and explain physical significance of Reynolds and Nusselt number.
- Explain Fin efficiency and Fin effectiveness. Explain in brief factors affecting fin effectiveness.
- Exhaust gases ($C_p = 1.12 \text{ kJ/kg }^{\circ}\text{C}$) flowing through a tubular heat exchanger at the rate of 1000 Kg/hr are cooled from 300°C to 120°C . The cooling is affected by water ($C_p = 4.18 \text{ kJ/Kg }^{\circ}\text{C}$) that enters the system at 20°C at the rate of 1200 Kg/hr. If the overall heat transfer coefficient is $140 \text{ W/m}^2 \text{ K}$, what heat exchanger area is required to handle the load for parallel flow arrangement?
- Define intensity of radiation. What is solid angle? Explain.

Q2) a) Derive general equation of heat conduction in Cartesian coordinate system and reduce it to all three forms.

10

- Air at atmospheric pressure and 20°C flows with 5 m/s velocity through main duct of an air conditioning system. The duct is rectangular in cross-section and measures $40 \text{ cm} \times 80 \text{ cm}$. Determine heat loss per meter length of duct corresponding to unit temperature difference. The relevant thermo-physical properties of air are

10

$$v = 15 \times 10^{-6} \text{ m}^2/\text{s}, \alpha = 7.7 \times 10^{-6} \text{ m}^2/\text{hr}, k = 0.026 \text{ W/m K}$$

Use Dittus Boelter correlation : $\text{Nu} = 0.023 \times (\text{Re})^{0.8} \times (\text{Pr})^{0.4}$ Q3) a) Water flows at the rate of 65 kg/min through a double pipe counter flow heat exchanger. Water is heated from 50°C to 75°C by oil flowing through the tube. The specific heat of oil is 1.780 kJ/kg K . The oil enters at 115°C and leaves at 70°C . The overall heat transfer co-efficient is $340 \text{ W/m}^2 \text{ K}$. Calculate the following

8

- Heat exchanger area
- Rate of heat transfer

Use LMTD method.

- b) The following data pertains to the junction of a thermocouple wire used to measure the temperature of a gas stream : 6
 $\rho = 8500 \text{ Kg/m}^3$; $C_p = 325 \text{ J/kg K}$; $k = 40 \text{ W/m K}$ and the heat transfer coefficient between the junction and gas $h = 215 \text{ W/m}^2 \text{ K}$.
 If thermocouple junction can be approximated as 1 mm diameter sphere, determine how long it will take for the thermocouple to read 99 percent of the initial temperature difference?

- c) Define the following terms: (i) Absorptivity (ii) Reflectivity (iii) Transmissivity. 6
 (iv) Emissivity. Explain Kirchoff's law.

- Q4) a) A rod of 10 mm diameter and 70 mm length with thermal conductivity 15 W/m K protrudes from a surface at 180°C . The rod is exposed to air at 30°C with a convection coefficient of $25 \text{ W/m}^2 \text{ K}$. How does the heat flow from this rod get affected if the same material volume is used for two fins of the same length? Assume short fin with end insulated. 8

- b) In which mode of heat transfer is the convection heat transfer coefficient usually higher, natural convection or forced convection? Why? 4

- c) Derive an expression for LMTD for parallel flow type heat exchanger. 8

- Q5) a) Determine the radiant heat exchange in W/m^2 between two large parallel steel plates of emissivities 0.8 and 0.5 held at temperatures of 1000 K and 500 K respectively, if a thin copper plate of emissivity 0.1 is introduced as a radiation shield between the two plates. 10
 Take $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$

- b) What do you mean by critical thickness of insulation? State its importance. Derive an expression for critical radius of insulation for sphere of thermal conductivity k and outside film coefficient h_o . 10

- Q6) a) Draw a neat boiling curve for water showing different regions of boiling. Explain each regime in brief. 6

- b) Estimate the heat transfer from a 40W incandescent bulb at 125°C to 25°C in quiescent air. Approximate the bulb as a 50 mm diameter sphere. What percent of power is lost by free convection? The appropriate correlation for the convection coefficient is 8

$$Nu = 0.60 \times (Gr Pr)^{0.25}$$

The thermo-physical properties of air at mean film temperature are : $\nu = 20.55 \times 10^{-6} \text{ m}^2/\text{s}$,

$$k = 0.03 \text{ W/m K} , Pr = 0.693$$

- c) A $250 \times 250 \text{ mm}$ ingot casting, 1.5 m high and at 1025 K temperature, is stripped from its mold. The casting is made to stand on end on the floor of a large foundry whose wall, floor and roof can be assumed to be at 300 K temperature. Make calculation for the rate of radiant heat interchange between the casting and the room. The casting material has an emissivity of 0.85. 6
 Take $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$

Time: 3 Hours

Total Marks: 80

- N.B. 1. Question No.1 is compulsory.
2. Answer **any three** questions from remaining questions.
3. Assume suitable data if required.
4. Figure to the right indicates full marks.

Q. 1 Solve any FIVE

20

- State the different types of governors.
- Explain the term critical speed of rotating shaft.
- Explain Gyroscopic Couple
- Discuss the effect of damping on vibratory system.
- Why is balancing necessary for rotors of high speed engines?
- Explain in details condition monitoring and fault diagnosis.

Q. 2 a) The length of the arms of a Porter governor is 300mm long. The upper and lower arms are pivoted to links at 50mm and 60mm, respectively, from the axis of the rotation. The mass of each ball is 5kg and the sleeve is of mass 60kg. The frictional force on the sleeve is 35N. Determine speed range for extreme radii of rotation of 120mm and 150mm. 10

b) The total mass of a four wheel trolley car is 1800kg. The car runs on rails of 1.6m gauge and round a curve of 24m mean radius at 36 km/hr. The track is banked at 10° . The diameter of the wheels is 600mm. Each pair of wheels with axle has a mass of 180kg and radius of gyration of 240mm. The height of the C.G. of car above the wheel base is 950mm. Determine the pressure on each rail. 10

Q. 3 a) Explain Dynamically Equivalent System and correction Couple. 10

b) In a damped vibrating system, the mass having 20kg makes 40 oscillations in 25sec. The amplitude of natural vibrations decreases to one eighth of the initial value after 8 oscillations. Determine (i) the logarithmic decrement (ii) damping factor & damping coefficient (iii) spring stiffness. 10

Q. 4 a) How to convert multi-springs, multi dampers into a single spring and damper with linear or rotational coordinate system? 10

b) A machine part having a mass of 2.5kg vibrates in a viscous medium. A harmonic exciting force of 30N acts on the part and causes a resonant amplitude of 14mm with a period of 0.22 sec. Find the damping coefficient. If the frequency of the exciting force is changed to 4Hz, determine the increase in amplitude of forced vibrations upon the removal of the damper. 10

Q. 5 a) Determine the natural frequency of oscillation of a half solid cylinder of mass 'm' and radius 'r' when it is slightly displaced from mean position and released. 10

b) How does the force transmitted to the base change as the speed of the machine increases? Explain using an equation and the corresponding graph. 10

Q. 6 a) Explain the principle of vibration measuring instruments and working principle of any one amplitude measuring instrument. 10

b) Each crank and connecting rod of a four crank in-line engine are 200mm and 800mm respectively. The outer cranks are set at 120° to each other and each has a reciprocating mass of 200kg. The placing between adjacent planes of cranks are 400mm, 600mm and 500mm. If the engine is in complete primary balance, determine the reciprocating masses of the inner cranks and their relative angular positions. Also find the secondary unbalanced force if the engine speed is 210rpm. 10

Total Marks: 80

(4) Figures to the right indicates full marks.

-
- Technical drawing of a mechanical part with the following dimensions and features:
- Overall width: 29
 - Overall height: 45
 - Distance between centerlines of two circular holes: 24
 - Distance from the left edge to the centerline of the holes: 12
 - Distance from the bottom edge to the centerline of the holes: 30
 - Radius of the circular holes: $\varnothing 8 - 2 \text{ OFF}$
 - Internal rectangular feature dimensions: 5 (width), 16 (height)

Unspecified Radii: 1 mm

Figure No: 1

3. (a) A circular cup as shown in figure no. 2 is manufactured by using deep drawing operation. (Material: MS Cup, Thickness: 2mm, Yield Strength: 35 kgf/mm²). Determine following.
- Blank size
 - Percentage reduction
 - Number of draws
 - Radius on punches and dies
 - Die clearance, punch diameter and die opening size at each draw
 - Drawing force and blank holding force

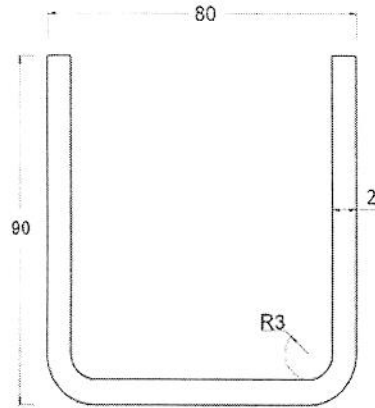


Fig No.2
Deep Drawn Component
(All Dimensions are in mm)

4. (a) Calculate the developed length of the part shown in fig no. 3.
(Material: Steel, Ultimate tensile strength: 450 N/mm^2 , thickness: 3mm)

5

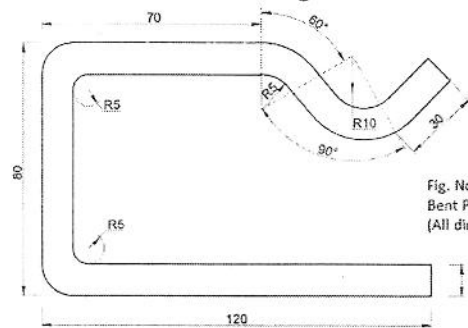


Fig. No.4
Bent Part
(All dimensions are in mm)

- (b) With your own example explain how to determine the coordinates of the centre of pressure of blanked part. 5
- (c) Explain the condition of energy overloading of press. 5
- (d) Differentiate between stopper and pilot. 5
5. (a) Discuss safety procedures and devices adopted for both press operator and equipment. 7
- (b) Discuss methods of feeding the strip/coil material in the press. 7
- (c) Explain working and construction of embossing die. 6
6. Answer the following (Any four): - 20
- (a) Explain with neat sketch construction and working of shaving dies.
- (b) What is spring back in bending operation? How spring back is prevented in V dies and wiping dies.
- (c) List drawing defects, also explain probable causes for the development of any four defects.
- (d) Explain the following terms in relation to mechanical press:
i) press tonnage ii) throat iii) distance between uprights.
- (e) Draw a neat and dimensioned sketch of Acron type pilot to be used in locating hole of 18mm diameter.

TE (Mech) (Choice based) (VI) 10th May 2019

(3 Hours)

[Total Marks: 80]

Instructions:

- (1) Question No.1 is compulsory and Answer 3 Questions remaining 5 Questions.
- (2) Assume suitable data wherever necessary
- (3) Concepts explanation with suitable case study justification
- (4) Diagram and sketches explanations are right to reserve full marks

Q1 Answer Any Four Questions

- a) Write a short note on Nano Metrology. 20
- b) Explain Eddy current testing methods.
- c) Write a note on CMM and enlist its types.
- d) Explain Surface irregularities with sketches measuring parameters R_a , R_z , R_y and RMS.
- e) What is Metrology? Explain different types of standards.

Q2 a) Derive an expression for determination of effective diameter of threads by using two wire method. 10

- b) Define Interferometry. Explain Laser Interferometer with neat sketch. 10

Q3 a) Explain the floating carriage micrometer with principle, construction, and measurement of threads. 10

- b) Explain Significance of Quality & Quality Control in Industries with suitable examples. 10

Q4 a) Explain the pneumatic comparator with principle, construction, and operation in detail. 10

- b) Explain various SQC Tools in quality engineering in detail. 10

Q5 a) Calculate the limits, tolerances, and allowances on a 25 mm shaft and hole pair designated H7/g6 to get a precision fit. The fundamental tolerance is calculated by the following equation: 10

$$i = 0.453 \sqrt[3]{D} + 0.001D$$

The following data is given:

- (i) Upper deviation of shaft = $-2.5D^{0.34}$
- (ii) 25 mm falls in the diameter step of 18–30 mm
- (iii) IT7 = $16i$
- (iv) IT6 = $10i$
- (v) Wear allowance = 10% of gauge tolerance.

- b) Explain the Parkinson Gear Tester with sketches in Gear profile checking process. 10

Q6 Answer Any Two Questions 20

- a) Explain Autocollimator with sketches and its working principle in detail.
- b) What is acceptance sampling? Explain OC Curve in detail.
- c) Explain in detail - Design of GO and NO-GO gauges procedure with diagram.

TE (Mech) / Sem - VI / Choice based

Date: 16/5/2019

Duration: 3Hrs

Marks:80

Instructions:

- i) Question No.1 is compulsory
- ii) Solve any three questions from the remaining
- iii) Assume suitable data wherever necessary
- iv) Figure to the right indicates marks
- v) Use of design data book is permitted

- Q.1 Solve any four questions from following**
- a) Write the general procedure for designing any machine component. (05)
 - b) What is the difference between endurance limit and fatigue strength of a material? (05)
 - c) "Curved beams cannot be designed by applying the simple bending theory of straight beams" Justify the sentence. (05)
 - d) Compare the weight, strength and stiffness of a hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length. (05)
 - e) Explain the surface finish factor and size factor with respect to machine element subjected to variable load. (05)
- Q.2**
- a) Design a socket and spigot type of cotter joint to transmit reversible load of 80 KN. Select suitable materials for various parts. (14)
 - b) Derive the Lamé's equation for thick cylinder subjected to an internal pressure only. (06)
- Q.3**
- a) A shaft is supported in bearings A and B 1000 mm apart. An involute gear having PCD of 400 mm is located 300 mm to the right of LH bearing and 600 mm diameter pulley is mounted 350 mm to the left of RH bearing. The gear is driven by a pinion located vertically above, while the pulley transmits power via belt to a pulley located vertically below. The ratio of belt tensions is 2. The pulley weigh 2500 N. Design the shaft, if power transmitted is 30 KW at 400 rpm. The shaft rotates clockwise when viewed from left side. (12)
 - b) A circular bar of 50 mm is weld to a steel plate by an annular fillet weld and is subjected to a twisting moment of 2 KN-m. If the allowable shear stress in the weld material is 85 MPa. Determine the size of the weld. (08)
- Q.4**
- a) Design a bush type of flexible coupling for connecting a reduction gear shaft to a stone crusher shaft. The unit is driven by 720 rpm motor through 5:1 reduction. Choose the type of coupling and write all the dimensions and design the shaft. (14)
 - b) Classify different engineering materials in details. (06)

- Q.5 a) A semielliptical leaf spring is used for the suspension of a rear axle of a truck. It consists of two extra full length leaves and ten graduated leaves including master leaf. The centre to centre distance between the spring eyes is 1.2 m. The leaves are made of steel whose σ_{yt} is 1500 N/mm^2 and Young's modulus is 207000 N/mm^2 and FOS is 2.5. (14)
The spring is to be designed for maximum force of 30 KN. The leaves are prestress so as to equalize the stresses in all leaves. Determine cross section of leaves, the deflection at the end of spring and length of the all leaves by considering ineffective length 80 mm.
- b) What is service factor? State its significance. (06)
- Q.6 a) Design a bottle screw jack for lifting a load of 250 KN and having maximum lift of 270 mm. Select proper material and draw a neat proportional sketch. (14)
- b) Explain fatigue test machine with neat sketch? (06)

Note:

1. Question 1 is Compulsory
2. Solve any three from remaining five
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Q.1 Attempt any four

20

- Explain different types of Boundary conditions giving examples.
- Write element matrix equation in the following fields explaining each term:
 - 1D steady state, heat transfer by conduction
 - Torsion Analysis
- Explain Subparametric, Isoparametric and Superparametric elements.
- Explain plane stress and plane strain conditions with examples.
- Explain the significance of shape functions.

Q.2

- Solve the following differential equation using Method of least square and point Collocation method.

10

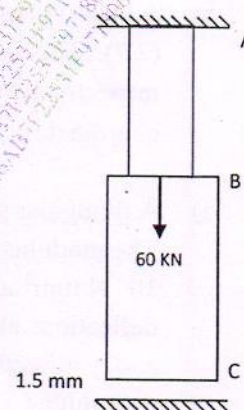
(Assume collocation points $x = 0.25$ and 0.5)

$$\frac{d^2 \Phi}{dx^2} - \Phi = x; 0 \leq \phi \leq 1; \phi(0) = 0, \phi(1) = 0$$

Compare answer with exact solution at $x = 0.5$

- A bar ABC shown in figure is subjected to a load of 60kN at B with a clearance of 1.5mm below the section at C. Area of AB is 150 mm² and length is 1.5m. Area of BC is 240 mm² and length is 3 m. Compute stresses in AB and BC. $E=200$ GPa.

10



Q.3

- Develop the Finite Element Equation for the most general element using Rayleigh Ritz method for a vertical bar with axial loading. The governing differential equation is

10

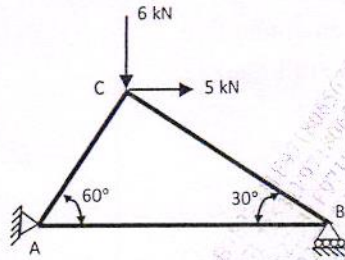
$$\frac{d}{dx} \left(EA \frac{du}{dx} \right) + f = 0 \quad ; \quad 0 \leq x \leq L$$

where f is the weight of the bar per unit length.

- Derive the shape function for a rectangular element in local coordinate system and show its variation over the element.

10

- Q.4 a) Compute the stress developed in the members of the truss shown in figure. $E=200$ GPa. Area of the member AB is 20 cm^2 and its length is 5m . Members BC and AC have the same area and is equal to 25 cm^2 . 10

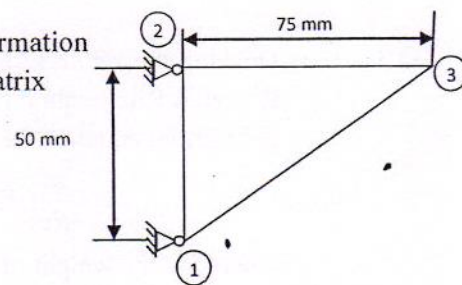


- b) What do you mean by consistent and lumped mass matrices? Derive the same for linear bar element. 10
- Q.5 a) Evaluate the natural frequencies for the bar with varying cross sections shown in figure. $L = 200 \text{ mm}$, $E = 200 \text{ GPa}$ and $\rho = 8000 \text{ kg/m}^3$. Consider two elements of equal lengths. 10



- b) A quadrilateral element is defined by the coordinates (1,4), (4,2), (5,6) and (2,7). The temperatures at the nodes are 20°C , 30°C , 40°C and 25°C respectively. Determine the temperature at a point which has local coordinates $\xi = 0.123$ and $\eta = -0.369$ and also its cartesian coordinates. 10
- Q.6 a) A triangular plate of size $75\text{mm} \times 50 \text{ mm} \times 12.5 \text{ mm}$ is as shown in figure. The modulus of elasticity and Poisson's ratio for plate material are $200 \times 10^3 \text{ N/mm}^2$ and 0.25 respectively. Upon loading of the plate, the nodal deflections at node 3 were found to be 0.01552mm and -0.0004 mm in x and y direction respectively. Model the plate with CST element and determine : 12

- The Jacobian for $(x,y) \rightarrow (\xi,\eta)$ transformation
- The strain-displacement relation matrix
- The stress in plate



- b) Explain Convergence criteria. What do you understand by h & p method of Finite Element Analysis? 08

T.E sem-VI (Mech), choice Based 28/05/2019.

(3 Hours)

[Total Marks 80]

Note: 1) Question no. 1 is compulsory.

2) Attempt any **three** questions out of the remaining **five** questions.

3) Clearly mention the assumptions made if any.

4) Use of Refrigerant Tables, P-h chart, Friction chart, Psychrometric Chart and Steam table is permitted.

Q.1 Answer any **Four** of the following:

20

- List down the types of aircraft air cooling systems. Draw T-s Diagram for Simple Air Evaporative Cooling System
- Draw VCR Cycle on P-h diagram with sub-cooling of liquid refrigerant in condenser & explain the processes involved in the cycle.
- What is Eypass factor? Explain it for heating and cooling coil.
- Define & explain RSHF, GHSF and ERSHF.
- What is Human Comfort? Explain with the help of ASHRAE Comfort Chart.
- In a refrigeration plant working on Bell-Coleman cycle, air is compressed to 5 bar from 1 bar. Its initial temperature is 10°C . After compression, the air is cooled upto 20°C in a cooler before expanding back to a pressure of 1 bar. Determine Theoretical COP & Net Refrigeration Effect of the plant. Take $\gamma = 1.4$ for air.

Q.2 a) The following data refers to Simple Air Refrigeration Cycle of 20TR capacity.

Ambient air temperature & pressure = 20°C & 0.8 bar

Ram air pressure = 0.9 bar

Compressor outlet pressure = 3.6 bar

Temperature of air leaving H.E. = 60°C

Pressure of air leaving the turbine = 1 bar

Temperature of air leaving the cabin = 27°C

Compressor & Turbine efficiency = 80% & 75% respectively

Assume no pressure drop in H.E. & isentropic ramming process. Calculate;

- Mass of air circulated per minute.
- Power required.
- COP.

12

- Classify Ducts & derive an expression for an equivalent diameter of a circular duct for rectangular duct for same frictional loss per unit length when quantity of air flowing through both ducts is same.

08

Q.3 a) A Vapour Compression Refrigeration System using NH_3 works between -15°C and 40°C as evaporator and condenser temperature respectively. The vapour is superheated by 5°C before entering compressor & liquid is sub-cooled by 5°C before leaving the condenser. Using P-h chart, determine;

- COP
- Mass of Refrigerant per TR
- Piston Displacement per TR using Volumetric efficiency = 80%
- Heat rejected in the condenser per TR
- Ideal COP

12

69127

Page 1 of 2

- b) Explain Sensible Heating, Sensible Cooling, Humidification and Dehumidification process. 04
- c) Classify Cooling Towers & explain its application. Define Range & Approach. 04

Q.4 a) The specific humidity of atmospheric air at 28°C DBT and barometric pressure of 760 mm of Hg is 0.016 Kg/Kg of dry air. Determine the following without using Psychrometric chart:

- Partial pressure of water vapour.
- Relative Humidity.
- Dew Point Temperature.
- Specific Enthalpy.

08

- b) Derive an expression for COP of an Ideal Vapour Absorption Refrigeration System. 06
- c) Describe various psychrometric processes in an Air washer. 06

Q.5 a) The following data is given for Summer air conditioning of a building:

Outside design conditions = 43°C DBT, 27°C WBT

Inside design conditions = 25°C DBT, 50%RH

Room Sensible Heat Gain = 84,000 kJ/hr

Room Latent Heat Gain = 21,000 kJ/hr

By-Pass Factor of cooling coil = 0.2

The return air from the room is mixed with the outside air before entering the cooling coil in the ratio of 4:1 by mass. Determine:

- Apparatus Dew Point of the cooling coil.
- Inlet & Outlet conditions of air for cooling coil.
- Fresh air mass flow rate.
- Refrigeration load on the cooling coil in TR.

14

- b) Classify Refrigerants with example of each type. Which refrigerants are considered environment friendly? Explain. 06

Q.6) Write short note on any Four of the following: 20

- BEE Star Rating System.
- Types of Compressors & Expansion Devices.
- Thermoelectric Refrigeration.
- Green Buildings.
- Vortex Tube Refrigeration.
- Deep Sea Water Air Conditioning.

T.E. Sem-VI Mechanical Engg. Choice Base 23/05/2019

(3 Hours)

[Total: 80 marks]

N.B.

1. Question 1 is compulsory.
2. Attempt any three questions from the remaining five questions.
3. Assume suitable data, if necessary.
4. Figures/sketches carry weightage.

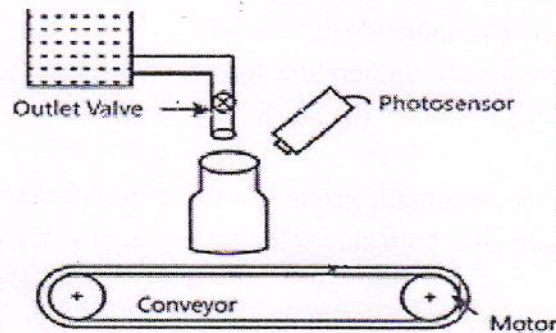
- Q1 a. Differentiate between Capital- Intensive Vs Low Cost automation. 5
 b. Explain in detail Basic elements of an automated system. 5
 c. Write note on Components of FRL Unit. 5
 d. Explain the types of temperature sensor, also select the sensor based on the parameters (a) Accuracy (b) Sensitivity. 5
- Q2 a. Design electro pneumatic circuit for three cylinder operation with following sequence using 4/2 both side solenoid operated valve as DCV. 12
 A+ B+ C+ C- B- A- (with grouping)
 With user selection option single cycle & Multicycle operation. Apply the emergency condition when applied all the three cylinders must reach their home positions.
 b. Explain with a neat sketch various parts and working of vibratory bowl. 8
- Q3 a. Write detail note on Robot Configurations with respect to joints, applications, advantages & Disadvantages. (any three) 10
 b. Design simple hydraulic circuit for two cylinder operation with following sequence using 4/2 both side pilot operated valve as DCV. 10
 A+ B+ C+ B- A- DELAY C-
 With user selection option single cycle & Multicycle operation.
- Q4 a. List & Discuss Ten strategies of automation & Production system 10
 b. Differentiate between PLC & Relay operation 5
 c. Differentiate between Continuous verses discrete control 5

Q5 a. Design PLC Ladder diagram for water bottle filling mechanism

15

Process Description:

Whenever bottles are placed on the conveyor, motor starts and conveyor moves and when photo sensor senses the bottle, motor stops and outlet valve opens for 30 sec. After 30 sec valve is closed, motor starts and conveyor moves. When another bottle is detected, the process is repeated. Implement this in PLC using Ladder Diagram programming language. Refer following figure



b. Write short note on acceleration sensor

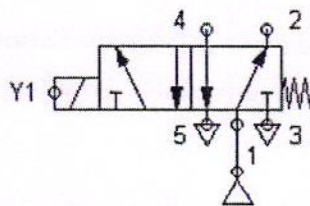
5

Q6 Write short note on following (5 marks each)

20

a. Brushless DC Motors

b. Identify following valve specification & discuss in detail.



c. AS/RS system

d. Applications of robot

(3 Hours)

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

Q1 Answer any **Four** from the following

- a) Explain how assumptions made in Lewis equation are taken into account during design. 5
 b) Discuss advantages and disadvantages of rolling contact bearings over sliding contact bearings. 5
 c) Explain the significance of pressure angle in cam and follower design. 5
 d) Discuss the desirable properties of friction materials and least out at least two friction materials. 5
 e) Discuss the advantages and disadvantages of belt drives as compare to the chain or gear drive. 5

Q2 It is required to design a two stage spur gear reduction unit with 20^0 full depth involute teeth. The input shaft is connected to 10KW, 1440 rpm motor through a flexible coupling. The speed of output shaft shall be approximately 180 rpm. The starting torque of motor is 150% of rated torque. The gears are made of plain carbon steel with ultimate tensile strength of 700 N/mm^2 and heat treated to a surface hardness of 340 BHN. Design the gear and specify the dimensions. 20

Q3 a) A worm and worm wheel drive is required to transmit power from an electric motor rated at 11KW and 1440 rpm with reduction ratio of 15. The power is supplied to a belt conveyor which operates for 12 hours per day. Selecting suitable material and stresses, design worm and worm wheel for strength and wear. Do not check for heat dissipation capacity. 10

Q3 b) A ball bearing mounted on 90 mm shaft operates on the following work cycle. 10

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

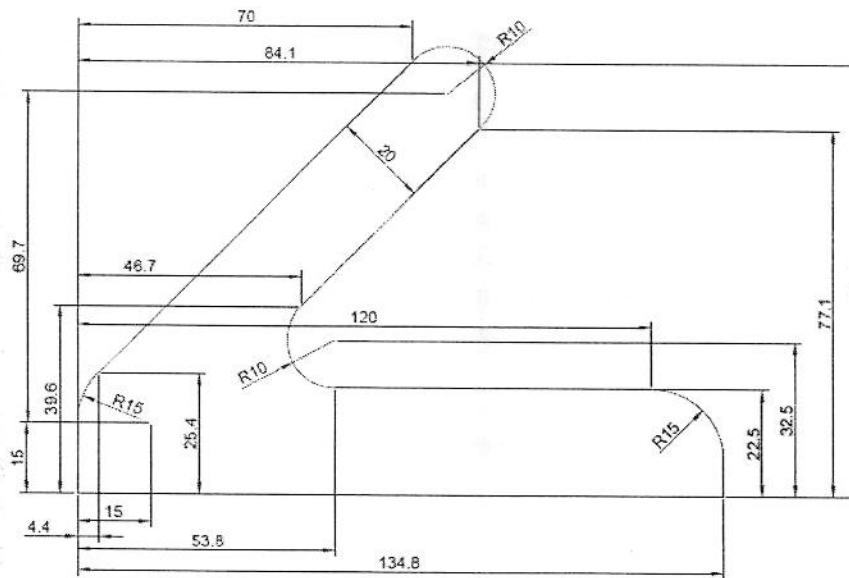
Select a suitable bearing for a life of 10,000 hours with 93% probability of survival.

- Q4 a) The following data is given for 360° hydrodynamic bearing. 10
 Radial load = 10KN, Journal speed = 1450 rpm, L/D ratio = 1,
 Bearing length = 50mm, Radial clearance = 20 microns, Eccentricity = 15 microns
 Calculate
 1) The minimum oil film thickness
 2) The coefficient of friction
 3) Power lost in friction
 4) Viscosity of lubricant in Centipoise
 5) The total flow rate of the lubricant in liters per minute.
- Q4 b) Design a chain drive to meet following specifications 10
 Input Power = 5.5 KW
 Input speed = 300 rpm
 Output speed = 100 rpm
- Q5 A cone clutch is required to transmit 11 KW at 960 rpm. Design following components by selecting suitable materials and design stresses. 20
 1) The Cone 2) The Cup 3) The Spring 4) The driven shaft
 Draw neat sketches of above components and indicate dimensions. Assuming that the time for each engagement = 0.125 seconds and 30 engagements takes place per hour. Determine steady state temperature of the cup outer surface. Consider that the entire heat generated during engagement is transferred to the cup and heat dissipation takes place from the outer surface of cup.
- Q6 a) A rotary disc cam with central translatory roller follower has following motion. 10
 Forward stroke of 25 mm in 120° of cam rotation with SHM motion, Dwell of 60° of cam rotation and return stroke of 25 mm in 100° of cam rotation with SHM. Remaining dwell to complete the cycle. Mass of the follower is 1 Kg and Cam shaft speed is 500 rpm. The maximum pressure angle during forward stroke and return stroke is limited to 25°. The external force during forward stroke is 300 N and that of return stroke is 50 N.
 1. Draw Displacement, Velocity and Acceleration time diagram
 2. Find prime circle radius, Base circle radius
 3. Calculate radius of curvature of pitch curve and Cam profile
 4. Determine width of the cam
- Q6 b) Determine size of a rubber canvas flat belt to transmit 5.5 KW 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
-

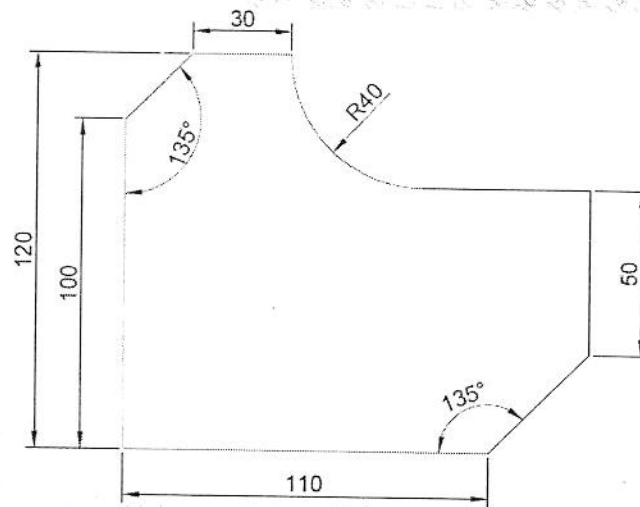
(3 Hours)

Note:

- | | | |
|-----|--|----|
| Q.1 | a) Explain an algorithm for hidden surface removal | 5 |
| | b) Explain reflection with respect to 3D transformation | 5 |
| | c) Explain the significance of rapid prototyping in product development and testing | 5 |
| | d) Explain the roughing and finishing canned cycle for turning. | 5 |
| Q.2 | a) Plot the bezier curve having end points $P_0(1, 1)$ and $P_3(3, 1)$. The other control points are $P_1(2, 1)$ and $P_2(4, 3)$. Also find the midpoint of the curve. | 10 |
| | b) Explain Fused Deposition Modelling | 10 |
| Q.3 | a) Write a complete part program to machine the external contour for the component shown. | 10 |



- b) Explain Adaptive control system by explaining ACC and ACO 10
- Q.4 a) A rectangle ABC has vertices A (5, 10), B (20, 10) and C (20, 20). This triangle is to be reflected about a line P (25, 20) and Q (10, 30). Determine the new triangle position. 10
- b) Explain the procedure of kinematic analysis of a structural system with an example. 10
- Q.5 a) Write a part program in APT for the component shown in Fig using end mill cutter of 20mm diameter. Clearly show the axes system chosen with a sketch and the direction of the cutter for the motion statements. 10



- b) Explain the basic components of CIM system. 10
- Q.6 Write short note on any **Four**: 20
- Benefits of AI
 - Constructive solid geometry and Boundary representation
 - Feedback Devices
 - Advantages of Computer aided part programming as compared to manual part programming
 - Photolithography

(Revised course)

Time duration: 3 Hours

[Total Marks: 80]

- Note: 1) Question no. 1 is compulsory.
2) Attempt any three questions out of the remaining five questions.
3) Clearly mention the assumptions made if any.

Q 1. Attempt any 4 of the following;

(20)

- Differentiate between reciprocating compressor and centrifugal compressor
- Explain external gear pump with diagram.
- Explain methods of improving isothermal efficiency of reciprocating compressor.
- A double acting reciprocating pump takes in water from 3m and delivers at 45 m when running at 50 rpm. Its diameter and stroke are 18 cm and 36 cm respectively. Find the power required to drive the pump if mechanical efficiency is 85%. Also find the discharge of pump. Neglect the area of piston rod.
- Write a note on load-unload test.

Q 2. a) Explain construction and working of multi-stage reciprocating air compressor with intercooler with help of neat labelled schematic diagram and PV diagram.

(8)

b) A centrifugal pump discharges $0.15 \text{ m}^3/\text{s}$ of water against a head of 12.5 m, the speed of the impeller being 600 rpm. The outer and inner diameters of impeller are 500 mm and 250 mm respectively and the vanes are bent back at 35° to the tangent at exit. If the area of flow remains 0.07 m^2 from inlet to outlet, calculate: (i) Manometric efficiency of the pump, (ii) Vane angle at inlet, and (iii) Loss of head at inlet to impeller when the discharge is reduced by 40% without changing the speed.

(12)

Q 3. a) Explain construction and working of axial compressor with neat labelled diagram.

(8)

b) A centrifugal compressor running at 1440 rpm, handles air at 101 kPa and 20°C and compresses it to a pressure of 6 bar isentropically. The inner and outer diameters of the impeller are 14 cm and 28 cm respectively. The width of the blade at inlet is 2.5 cm. The blade angles are 16° and 40° at entry and exit. Calculate mass flow rate of air, degree of reaction, power input and width of blades at outlet.

(12)

Q 4. a) Derive an expression for work done by the impeller of a centrifugal pump on liquid per second per unit weight of liquid.

(8)

b) The LP cylinder of a two-stage double-acting reciprocating air compressor running at 120 rpm has a 50 cm diameter and 75 cm stroke. It draws air at a pressure of 1 bar and 20°C and compresses it adiabatically to a pressure of 3 bar. The air is then delivered to the inter-cooler,

TURN OVER

where it is cooled at constant pressure to 35°C and is then further compressed polytropically (index $n=1.3$) to 10 bar in HP cylinder. Determine the power required to drive the compressor. The mechanical efficiency of the compressor is 90% and motor efficiency is 86%. (12)

Q 5. a) Two geometrically similar centrifugal pumps are running at the same speed of 1000 rpm. One pump has an impeller diameter of 0.3 meter and lifts water at rate of 20 liters per second against a head of 15 meters. Determine the head and impeller diameter of the other pump to deliver half the discharge. (6)

b) An axial-flow compressor of 50% reaction has a blade outlet angle of 30° . The flow velocity is 0.5 times the mean blade velocity. The speed of the rotor is 7500 rpm. The stagnation condition of air at the entry is 1.013 bar and 5°C and the static pressure at this section is 0.91 bar. Draw the velocity triangle and find the power required to run the compressor, mass-flow rate and mean diameter of rotor. The mean flow area is 0.35 m^2 . (8)

c) Explain working of a single-stage reciprocating air compressor with neat labelled diagram. (6)

Q 6. Attempt any four of the following; (20)

- a) Trouble shooting in centrifugal pump
 - b) Variable speed drive
 - c) Screw pump
 - d) Air vessels
 - e) Choking and surging in centrifugal pump
 - f) Methods of improving efficiency of pumping system
-

B.E. MECH / SEM-VII CBSE / 23/05/2019

(3 Hours)

Total Marks: 80

- N.B. 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

- A. Define the term Production Planning and Control and list down its need. (5)
 B. What are subsidiary orders? How do they differ from work orders? Give its examples. (5)
 C. What are the different types of inventories? (5)
 D. List down the details which a process sheet should contain. (5)
 E. Differentiate between CPM and PERT. (5)

- Q2. A. What are the functions of PPC system? (10)
 B. With the help of neat sketch, derive the equation for EOQ with instantaneous stock replenishment. (Basic inventory model) (10)
 Q3. A. Classify the following items into ABC and draw the ABC curve. (10)

Item No.	501	502	503	504	505	506	507	508	509	510
Annual consumption	300	2800	30	1100	40	2200	150	800	600	80
Unit Price (Rs)	10	15	10	5	5	10	5	5	15	10

- B. An investigation into the demand for water pumps manufactured by Joy Engineering Pvt. Ltd. resulted into the following historical data, (10)

Year	2012	2013	2014	2015	2016	2017
Sale (in hundreds)	28	33	37	48	54	68

Project the trend of sales for next 3 years.

- Q4. A Use graphical method to minimize the time required to process the following jobs on the machines. Calculate the total elapsed time to complete both the jobs. (10)

Job 1	Sequence	A	B	C	D	E
	Time (Hrs)	6	8	4	12	4
Job 2	Sequence	B	C	A	D	E
	Time (Hrs)	10	8	6	4	12

{TURN OVER}

- B. A workshop has four machines and four tasks for completion. Each of the machines can perform each of the four tasks. Time taken at each of the machines to complete each task is given in the table below. How should the tasks be assigned to machines to minimize requirement of machine hours? (10)

Task	Machine			
	A	B	C	D
	Processing time (Hrs.)			
I	51	77	49	55
II	32	34	59	68
III	37	44	70	54
IV	55	55	58	55

- Q5. A. What are the advantages and limitations of linear programming methods? (10)

A firm produces three products. These products are processed on three different machines. The time required to manufacture one unit of each of three products and the daily capacity of the three machines are given in the table below.

It is required to determine the daily number of units to be manufactured for each product. The profit per unit for product 1, 2, and 3 is Rs. 4, 3 and 6 respectively. It is assumed that all the amounts produced are consumed in the market. **Formulate** the mathematical linear programming model that will maximize the daily profit.

Machine	Time per unit (minutes)			Machine capacity (mins/day)
	Product 1	Product 2	Product 3	
M1	2	3	2	440
M2	4	-	3	470
M3	2	5	-	430

- B. List of activities for a job is given below. Job A must precede all others while job E must follow others. Apart from this, jobs can run concurrently. (10)

Jobs	Normal		Crash	
	Duration (days)	Cost (Rs)	Duration (days)	Cost (Rs)
A	5	3000	4	4000
B	6	1200	2	2000
C	4	1000	3	1800
D	5	1200	3	2000
E	3	1600	3	1600

- Draw the network and identify the critical path.
- Crash the network fully to find out minimum duration.
- If indirect costs are Rs. 300 per day, determine time cost trade off for the project

Q6. Write Short Notes on:-

- Pre requisites of PPC. (5)
- JIT and its seven wastes. (5)
- Two bin system. (5)
- Forward scheduling and backward scheduling. (5)

BE (MECH) Semr VII CB S GS

29/5/2019

(3 Hours)

[Total marks: 80]

- N.B. 1) Question No. 1 is compulsory.
 2) Attempt any three out of the remaining questions.
 3) Draw neat sketches and graphs to illustrate your answers.
 4) Assume suitable data wherever necessary.

Qu.1 Explain in brief:

[20]

- Expression for economic load sharing in power plant.
- Parameters affecting thermodynamic efficiency of combined cycle.
- Rainfall measurement methods.
- Essential components of nuclear reactors.

Qu.2 a) Explain the stages of coal handling system in detail.

[10]

b) Following data pertains to a power plant of 120MW capacity.

Capital cost = Rs. 1500 per kW

Interest and Depreciation = 10%

Annual running charges = Rs. 20 x 10⁶

Profit to be gained = 10% on capital

Energy consumed by the power plant auxiliaries = 5 % of generated.

Annual load factor = 0.6, Annual capacity factor = 0.5

Calculate:- 1) Reserve capacity of the plant

2) Cost of generation per kWh

[10]

Qu.3 a) With a neat diagram discuss the working of Liquid Metal Sodium Graphite Reactor power plant with its advantages and disadvantages. [10]

b) The run off data of a river at a particular site is tabulated below as shown in table:

Month	Mean discharge per month (Millions of Cu. m)	Month	Mean discharge per month (Millions of Cu. m)
Jan	40	July	75
Feb	25	Aug	100
Mar	20	Sept	110
Apr	10	Oct	60
May	0	Nov	50
June	50	Dec	40

1) Draw hydro-graph and find the mean flow.

2) Draw the flow duration curve

3) Find the power in MW available at mean flow if the head available is 95m and overall efficiency of generation is 87%.

Take each month of 30 days.

[10]

Qu.4 a) Explain construction and operation of different components of hydro-electric power plant with neat diagram.

[10]

b) Classify dust collector and explain Cyclone separator with neat diagram.

[10]

Qu.5 a) Comment and discuss the issue of energy crisis in developing countries like India.

[10]

b) What are the advantages of Fluidised Bed Combustion? Explain PFBC with neat sketch.

[10]

Qu.6 Write short note on following:

[20]

- Boiling Water Reactor.
- Tariff methods of Electrical Energy.
- Ash handling systems.
- Run-off measurement systems.

BE (MECH) sem. VII CBSEGS

29/5/2019

Time: 3 Hours

Marks: 80

- N.B: (1) Question no 1 is compulsory
 (2) Attempt any **three** out of remaining **five** questions
 (3) Figures to the right indicate full marks
 (4) Assume Suitable data if necessary
 (5) Notations carry usual meaning

Q.1 Answer **any four** of the following:

a) For the game $\begin{bmatrix} a & -b \\ -c & d \end{bmatrix}$ where a, b, c, d are all ≥ 0 prove that the optimal strategies are:
 $A[\frac{c+d}{a+b+c+d}, \frac{a+b}{a+b+c+d}]$; $B[\frac{b+d}{a+b+c+d}, \frac{a+c}{a+b+c+d}]$ and $v = \frac{ad-bc}{a+b+c+d}$. (05)

b) Solve the LPP by Graphical method:

$$\text{Maximize } Z = 100x_1 + 80x_2$$

$$\text{Subject to } 5x_1 + 10x_2 \leq 50$$

$$8x_1 + 2x_2 \geq 16$$

$$3x_1 - 2x_2 \geq 6$$

$$\text{And } x_1 \text{ and } x_2 \geq 0$$

(05)

c) Explain Bellman's Principle of optimality (05)

d) How do you test initial feasible solution for optimality by Stepping Stone method. (05)

e) Define a queue. State the characteristics of waiting line. (05)

Q.2 a) A jobbing shop has three machine groups, namely lathes, milling machines and grinders. It has an idle capacity of 350 hours, 500 hours and 150 hours per week respectively. It is offered products A, B and C to be manufactured. Each unit of product A yields RS.30, product B Rs.12 and product C Rs.15. The time taken by each unit of the three products on different machines is given in Table below:

	Lathe	Milling	Grinder
Product A	5	9	3
Product B	4	3	0
Product C	0	5	2

- i) How much quantity of products A, B and C must be manufactured every week to yield maximum profit?
 ii) What capacity of each machine remains idle after making these products? State clearly the assumptions if any, made by you. (10 marks)

b) A dentist schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on type of dental work to be done. The following summary shows the various categories of work, their probabilities and time needed to complete the work

Category	Time required (minutes)	Probability of category
Filling	45	0.40
Crown	60	0.15
Cleaning	15	0.15
Extraction	45	0.10
Check-up	15	0.20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic exactly as per scheduled arrival times, starting 8 A.M. Use following random numbers for handling the above problem. 40, 82, 11, 34, 25, 66, 17 and 79. (10 marks)

- Q.3 a) A captain of a cricket team has to allot five middle order batting positions to five batsmen. The average runs scored by each batsman at these positions are given in the table.

Batting Position	III	IV	V	VI	VII
Batsman					
A	40	40	35	25	50
B	42	30	16	25	27
C	50	48	40	60	50
D	20	19	20	18	25
E	58	60	59	55	53

Make the assignment so that the expected total average runs scored by these batsmen are maximum. (10 marks)

- b) Customers arrive at one person barber shop according to Poisson process with mean inter arrival time of 20 minutes. Customers spend on an average of 15 minutes in the barber's chair.

- What is the probability that a new arrival need not wait for the barber to be free?
- What is the expected number of customers in the barber shop?
- How much time can a customer expect to wait for his turn?
- How much time can a customer expect to spend in the shop?
- Management will put in another and hire another barber when customer's average time in the shop exceeds 1.25 hours. How much must the average rate of arrivals increase to warrant a second barber?

(10 marks)

- Q.4 a) The following table has all necessary information on availability of supply to each warehouse, the requirement of each market and unit transportation cost (in Rs.) from each warehouse to each market.

Warehouse		Market				Supply
		P	Q	R	S	
	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
Demand		7	12	17	9	

The shipping clerk has worked out the following schedule from his experience:
12 units from A to Q, 1 unit from A to R, 8 units from A to S, 15 units from B to R, 7 units from C to P, 1 unit from C to R.

- i) Check and see if the clerk has worked out the optimal schedule
- ii) Find optimal schedule and minimum total transportation cost. (10 marks)

b) There are two players in a game, Player A and Player B. Each of them randomly shows selected fingers of his right hand. If the sum of the number of fingers shown by both the players is an even number, then player B has to give money in rupees equivalent to the number of fingers shown by him to Player A; if the sum of number of fingers shown by both the players is an odd number, then Player A has to give money in rupees equivalent to the number of fingers shown by him to Player B. Construct the payoff matrix with respect to Player A and find optimal solution for this game. (10 marks)

- Q.5 a) A manufacturer is offered two machines A and B. A is priced at Rs.10,000 and running costs are estimated as Rs.1600 for each of the first five years, increasing by Rs.400 per year in the sixth and subsequent years. Machine B which has the same capacity as A, costs Rs 5000 but will have running costs of Rs.2400 per year for six years, increasing by Rs.400 per year thereafter. If money is worth 10% per year, which machine should be purchased? Assume scrap value to be negligible. (10 marks)

b) The demand for an item is deterministic and constant over time and it is equal to 24000 units per year and company can produce the item at a rate of 4000 per month. The cost of one setup is Rs.600 and the carrying cost is 20 paise per unit per month. The shortage cost of one unit is Rs.300 per year. Determine:

- i) The optimum manufacturing quantity and no. of shortages
- ii) The manufacturing time and the time between setup
- iii) Maximum inventory level in the cycle and
- iv) Total associated cost per year if the cost of an item is Rs.25 per unit. (10 marks)

- Q.6 a) Using **Big-M** method,
Minimize $Z=3x+8y$

Subject to $x + y = 200$

$$x \leq 80$$

$$y \geq 60$$

Where $x, y \geq 0$

(10 marks)

- b) Given the following data:

Job	1	2	3	4	5	6
Machine A	12	10	9	14	7	9
Machine B	7	6	6	5	4	4
Machine C	6	5	6	4	2	4

- i. Order of processing: A-C-B
- ii. Suggested sequence of Jobs: 5-3-6-2-1-4
- iii. Determine the total elapsed time for sequence suggested.
- iv. Is the given sequence optimal?
- v. If No, then determine the optimal sequence and total elapsed time associated with it. (10 marks)

B E C VIII) C (B S G S) C (M E C H) 8th May 2019

(Hours 3)

[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 and Kale Khandare is permitted
 - 4) Assume suitable data if necessary, giving justification

Q1 Answer any Four from the following

- a) Give the basic constructional details of different types ropes used in EOT crane. And what do you understand by 6×37 rope? 5
- b) Explain Methodology for mechanical system design with suitable example? 5
- c) State the significance of specific speed and NPSH in the design of a centrifugal pump? 5
- d) Explain why an I – section with $I_{xx} \leq 4 I_{yy}$ is selected for connecting rods of an I.C. Engine? 5
- e) Why cleaning of belt is necessary for belt conveyor? List down the usual types of cleaners. 5

Q.2 The following specification refers to an EOT crane.

20

Application - Class II

load to be lifted - 80 KN

Hoisting Speed - 6 m/min

Maximum lift – 10 m

- a. Select a standard hook, material and design stresses induced at the most critical section.
- b. Select suitable type and size of the wire rope for an expected life of 12 months.
- c. Design the pulley axle and select suitable bearing.
- d. Design the rope drum.

Q.3 A centrifugal pump directly coupled to a motor is required to deliver 1000LPM of water at 30°C against a total head of 25 m. 20

- a. Select the type of motor speed and determine the power.
- b. Determine the impeller diameter, inlet and outlet vane angles and no. of vanes.
- c. Design the impeller shaft.
- d. Design the shape of the volute casing.
- e. Decide diameters of the suction and delivery pipes.

TURN OVER

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- Q.4. Design the complete 20° troughing belt conveyer including drive for the following Specification. 20
- Material to be conveyed = Coal.
Maximum lump size = 100 mm.
Capacity = 250 TPH.
Inclination = 12°.
Center to centre distance = 100 m.
- Q.5. a) For the design of a 2 X 3 machine tool gear box with following specification. 15
- $N_{\min} = 100\text{rpm}$, $N_{\text{motor}} = 960\text{ rpm}$, GP ratio = 1.26
- i. Draw structural diagrams,
 - ii. Draw ray diagram and speed chart,
- Q5. b) Distinguish between gear pump and the centrifugal pump. 5
- Q.6. a) A four stroke single cylinder water cooled Diesel engine develops 7.5 KW brake power when operating at 1000rpm. 15
- a) Determine the size of engine (bore and stroke)
 - b) Design wet liner and cylinder.
 - c) Design piston with pin and piston rings
- Q.6. b) Explain arithmetic progression law of stepped regulation in multispeed gear box? 5

- N.B. 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.

Q.1 Short Answer questions. (Any Four)

20

- Analyzing layouts with computers with the help of CORELAP
- What are the different costs incurred while increasing the value of the product?
- Draw a FAST diagram considering the example of a 'Pen'.
- State the different steps involved in Method Study.
- Illustrate the concept of time value of money with the four variables involved in it.

Q.2 a. Define white productivity. What are the factors influencing Productivity of an Enterprise?

10

b. What are the steps involved in micro motion study? Describe five therbligs with their symbol, code, colour and description.

10

Q.3 a. Define the term element. What are the reasons for breaking a job into elements? What are the different types of elements?

10

b. What is the importance of plant layout? Explain types of layout with their advantages and disadvantages.

10

Q.4 a. Classify the different types of displays and different types of controls with respect to work system design.

10

b. Draw a Two handed process chart considering the example of assembly of 'Nut and Bolt'.

10

Q.5 a. Define Rating. Why is it necessary to apply rating to the actual time which an operator takes to perform an operation?

10

b. An operation involves the following elements given below with their related data,

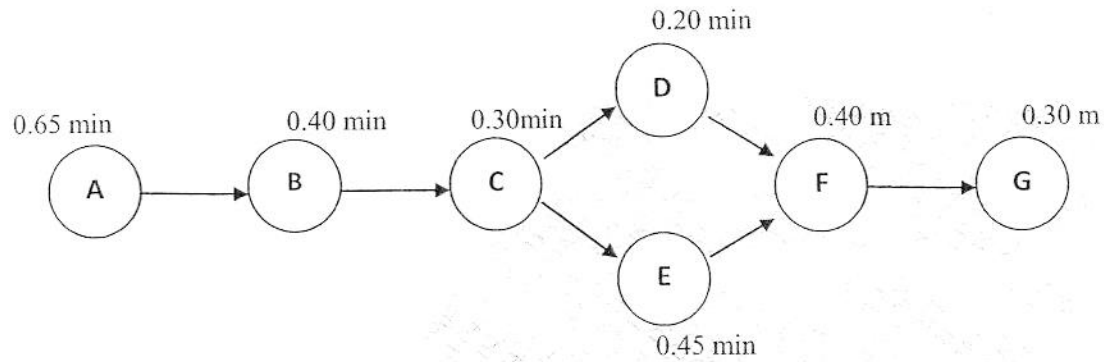
Element	Observed time (minutes)	Rating	Remarks
A	0.20	90	-
B	0.05	80	-
C	0.03	100	-
D	0.78	100	-
E	0.06	100	-
F	0.05	100	-
G	0.02	85	Once in 5 pieces
H	0.06	80	-
I	0.10	90	-
J	0.04	90	Once in 20 pieces

Assuming rest and personal allowances as 13% and contingency allowance as 2%, calculate standard time of the job.

10

Q.6 a. What do you understand by the term depreciation? What are the inputs required to calculate it? Give at least four different types of depreciation. 10

Q.6 b. The precedence diagram for assembly activities A to G is shown below. The element times required for the activities are shown in the diagram in minutes. The line operates for 7 hours per day and an output of 550 units per day is desired.



- Calculate cycle time and theoretical minimum number of workers.
- Group the task into an appropriate number of work stations.
- Calculate the balance efficiency.

03
04
03

BE (mech) | sem - VIII | CBSGS

20/5/2019

(3 Hours)

[Total Marks: 80]

- N.B.: (1) Question No. 1 is compulsory.
 (2) Answer any three from the remaining five questions.
 (3) Assumptions made if any should be justified.
 (4) Use of Refrigerant Charts, Psychrometric Chart, Friction Chart and Steam Tables are allowed.

1. Answer any four of the following.

[20]

- Draw simple vapour compression cycle on P-h diagram and explain the processes.
- What are non conventional refrigeration systems? Explain any one type.
- Air at $T_{db}=30^{\circ}\text{C}$ and $\text{RH}=40\%$ undergoes a constant humidity process until the final state is 20°C . Find i) Enthalpy of air at final state. ii) Cooling produced by the coil if the air flow is 200 CMM.
- List down types of aircraft refrigeration systems. Draw simple air cooling systems with neat schematic and T-s diagram.
- What is human comfort? Explain with help of ASHRAE Comfort chart.
- What are primary and secondary refrigerants? Give examples with application of each type.

2. a) A bootstrap air refrigeration system of 30 TR capacity is used for an aeroplane [12]
 flying at an altitude of 2000 m. The ambient air pressure and temperature are 0.8 bar and 0°C . The ram air pressure and temperature are 1.05 bar and 17°C . The pressure of air after isentropic compression in the main compressor is 4 bar. This air is now cooled to 27°C in another auxiliary heat exchanger and then expanded isentropically upto the cabin pressure of 1.01 bar. If the air leaves the cabin at 25°C and the efficiencies for the main compressor, auxiliary compressor and the cooling turbine are 80 %, 75 % and 80 % respectively; find : i) Power required to operate the system and ii. COP of the system

b) Classify refrigeration compressors. Explain each type in brief.

[08]

3. a) Define the terms DBT, WBT, DPT and RH.

[04]

b) What are the different types of Cooling Towers? Explain in brief.

Define Range and Approach.

[06]

c) Draw a neat diagram of Electrolux vapour absorption refrigeration system and explain its working.

[10]

4. a) A vapour compression system using Ammonia works between -25°C and 40°C as evaporator and condenser temperature respectively. Using P-h Chart, determine

[12]

- i) COP
 - ii) Mass of refrigerant per TR
 - iii) Piston displacement per TR using volumetric efficiency = 83 %
 - iv) Heat rejected in the condenser per TR
 - v) Ideal COP
 - b). Draw a neat sketch of Year Round Air Conditioning system and explain working of its components. [08]
5. a) What are the sources of cooling load for a Restaurant ? Discuss in details. [06]
- b) Define body temperature regulation and effects of extremes of hot and cold climate on human body. [06]
- d) A sling psychrometer reads 40 °C DBT and 28 °C WBT when atmospheric pressure is 750 mm of Hg. [08]
- Calculate using Steam Tables only i). Specific humidity ii). Relative humidity
iii). Dew point temperature iv). Enthalpy
6. Write short notes on any four. [20]
- a) Liquefaction of Gases
 - b) Duct Design Methods
 - c) Desirable Properties of Refrigerants
 - d) Thermoelectric Refrigeration
 - e) Star Rating of Air Conditioners
 - f) DART rating of Air Refrigeration Systems
-

B.E (Mech) sem - VIII C.B.S.G.S. 24/5/2019.

Time: 3 Hours

Marks: 80

- N.B. 1) Qu. 1 is compulsory
2) Solve any three questions out of remaining five.
3) Provide neat diagrams wherever necessary.
4) All questions carry equal marks.

- Qu.1) Write short note on following (Any Four) [20]
a) Final Drive.
b) Disc brake.
c) Stub axles.
d) Reversibility of Steering Gears.
e) Aerodynamic Drag.
- Qu. 2) A) Classify battery and explain Lead-Acid battery with neat diagram [10]
B) State the importance of vehicle body design explain three layouts each of Passenger car and bus. [10]
- Qu. 3) A) Stating the requirements of suspension, explain Wishbone type suspension systems in detail. [10]
B) What are the requirements of starting motors? Explain FOLO-through and Dyer drive. [10]
- Qu. 4) A) With neat diagram explain construction and features of Air suspension. [10]
B) Classify gear box and explain sliding mesh gear box with diagram. [10]
- Qu. 5) A) What is Electronic Control Module (ECM)? Explain. [10]
B) With neat diagram explain construction and working of Hydraulic braking system. [10]
- Qu. 6) Write short note on following. (Any four) [20]
a) Steering geometry
b) Differential
c) Alternator
d) Developments in Automobile sensor technology
e) classification of Tyres

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