Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

Previous Semester Examination December 2022

26/12/22.

Program: B.Tech. Mechanical Engineering T.Y. B.Tech (ME) Sem VI **Duration: 03 Hrs**

Course Code: PC–BTM612 **Maximum Points: 100**

Course Name: Machine Design **Semester: VI**

Notes: 1. Solve any **FIVE** questions.
2. Each question carries equal marks.
3. Assume suitable data wherever necessary and justify the same.
4. Use of **Machine Design Data Book** by **V. B. Bhandari** is permitted.

Q.No.	Questions	Points	CO	BL	PI
1	a) Describe Machinability and Castability properties of engineering materials. b) Give the designation of steel used for sprockets and Railway coaches. c) The tolerance of a shaft and bearing are H8/g7. If the nominal size of the shaft is 50 mm, determine the limits of dimensions of shaft and bearing. What is the type of fit? d) Explain the terms CLA and RMS. e) List the ergonomic considerations to be taken into account while designing a component	20	1	3	1
2	Design a cotter joint for the transmission of 25 KN tensile load. Allowable stress for all the three components, i.e., socket, spigot and cotter may be taken as follows: $\sigma_t = 50$ N/mm^2, $\sigma_c = 120$ N/mm^2, $\tau = 40$ N/mm^2.	20	1	1,2	2
3	a) Give practical example of high cycle fatigue. b) Explain fluctuating stress. Draw a stress time curve for fluctuating stress. c) A solid circular shaft, 15 mm in diameter, is subjected to torsional shear stress, which varies from 0 to 35 N/mm2 and at the same time, is subjected to an axial stress that varies from –15 to +30 N/mm2. The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of steel FeE 400 (Sut = 540 N/mm^2 and Syt = 400 N/mm2) and the corrected endurance limit of the shaft is 200 N/mm^2. Determine the factor of safety.	05 05 10	1	3	3

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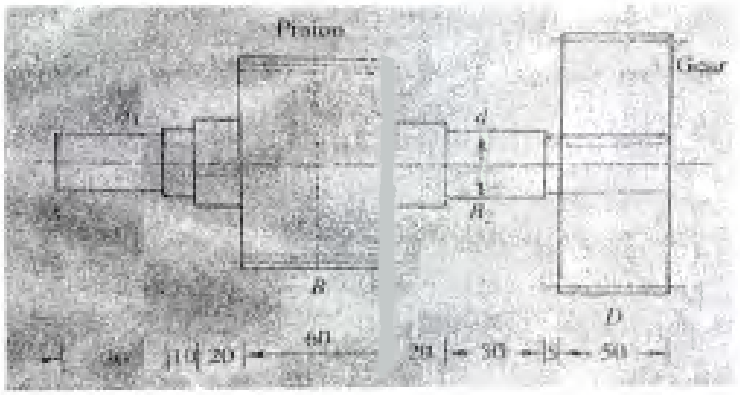
4	A pinion is the integral with the stepped shaft as shown in figure, and a gear is keyed to the shaft. The shaft is mounted on the bearings, B1 and B2, as shown in figure. The tooth loads on pinion and gear are in the same plane. The tooth load on pinion is 4.8 KN, and the tooth load on gear is 3.6 KN. The torque transmitted is 400 Nm. Determine the diameter of the shaft at the bearings if σyt = 360 MPa and FOS = 3. E = 205 X 103 KN/mm, and G = 80 KN/mm2. Take Kb = 2.0 and Kt = 1.5. 		1	3	4
5	a) A semi elliptical carriage spring for suspension in automobile has 3 extra full length leaves and 10 graduated length leaves, including the master leaf. The centre to centre distance between the two eyes of the spring is 1.1 m. Maximum force on the spring is 80 KN. For each leaf, b/t = 6. E for leaf material = 207 N/mm2. Leaves are pre stressed in such a way that when maximum force is applied, the stress in all leaves is 500 N/mm2. Determine: (a) b and t, (b) initial nip, and (c) pre load required to close the nip. b) A closed coil helical extension spring needs to be designed, for a spring balance with a capacity of 196.2 N. The spring index is to be taken as 8. Choose a suitable material and take the maximum allowable shear stress as 50 % of the ultimate tensile strength of the material. Give the specifications of the spring and make a simple sketch of the spring.	10 10	3	2,3	5
6	a) Select a belt from Dunlop high speed for power transmission of 11 KW from motor pulley running at 1440 rpm to machine pulley at 480 rpm. Centre distance between the pulleys is 2.4 m. Velocity of the belt can be taken from 14-16 m/s. Service factor as 1.2. Power	12	4	2,3	6

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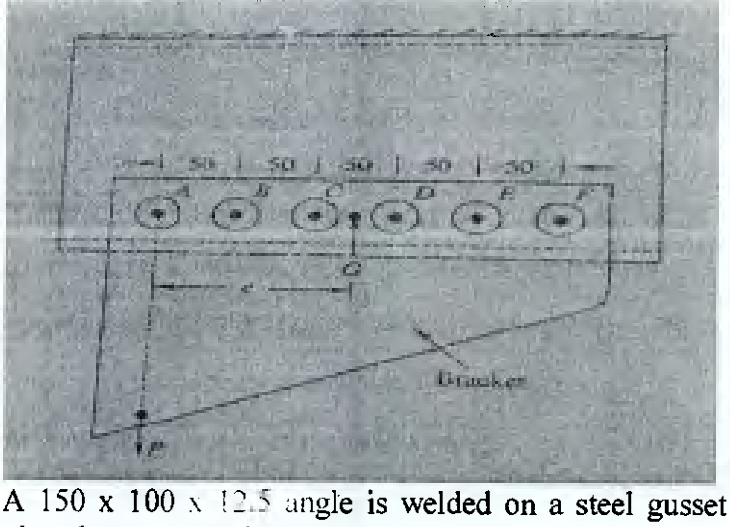
	transmission from high speed belt is 0.0118 KW per mm width per ply at V = 5 m/s. Take open belt drive system.	04			
	b) Explain the procedure for selection of a standard V belt.	04			
	c) What is polygon effect in chain drive? How this effect is minimized?				
	a) A bracket is connected to a channel in a structure through 6 rivets. If the eccentric load on the bracket is P=12 KN, and if maximum shear stress is not to exceed 100 MPa in any rivet, what is the size of the rivet? 	10			
	b) A 150 x 100 x 12.5 angle is welded on a steel gusset plate by means of two parallel fillet welds along the edges of length 150 mm. The angle is subjected to a tensile load of 350 KN. Determine the lengths of the weld required, if the load is applied with heavy shock. Assume suitable shear stress value.	05			
7	c) Determine the tensile stress area of M16 X 1.5 bolt.	05	2	3	7

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PREVIOUS SEM EXAM [redacted] DEC-2022	
DATE: 29-12-2022	SESSION:Afternoon
Class : Third Year B.Tech.in Mechanical Engineering Sem VI	Semester : VI
Course Name& Code-Manufacturing Planning and Control	PC-BTM605
Total Points 100	Time Allotted : 3hour

NB.
1.Que 1 is compulsory
2.Solve any 4 questions from remaining.
3.Assume Suitable Data wherever required
4 ND table are permitted.

28/12/22.

Q. NO	Question Statement	Points	Module	CO
Q1	For the company manufacturing packaged drinking water , explore the applications of various principles, methodologies, tools and techniques of the Manufacturing Planning and control. Answer should include 1. Market Survey and Forecasting 2. Capacity Planning 3. Manufacturing Requirement Planning 4. Material Requirement Planning 5. Master Production Scheduling 6. Quality Control , Quality Assurance 7. Use of JIT / Lean Practices 8. Use of Lean Six Sigma practices 9. Use of Simulation for Inventory control 10. Uses of Industry 4.0 Technology for improved operations	20	M1, M2, M3, M4, M5, M6, M7	CO1 CO3
Q2A	A firm produces three different products P1, P2 and P3. Each product needs to be processed through two departments, A and B. Department A has three machine A_1 A_2, and A_3 while B has two Machine B_1, B_2,. Product 1 can be manufactured on any type of A and B machines. Product 2 can be manufactured on A machine and Only on B_2 of B type machines. Product 3 can be manufactured on machines A_2 of type A and B_2 of type B. Time taken to manufactured one unit of each of product on each type of machine is given below. Formulate the L.P. model to maximize the profit.	10	M6	CO2

Machine	Product			Time Available per Week (Minute)	Cost/week at full capacity (Rs.)
	P1	P2	P3		
A_1	5	5	-	4500	270
A_2	6	8	10	95000	520
A_3	6	8	-	7500	450
B_1	7	-	-	3500	220
B_2	4	8	8	5100	310
Material					
Cost (Rs.)	0.45	0.55	0.65		
Sale Price (Rs.)	1.90	1.80	2.70		

Q2B Find the optimal sequence of jobs that minimizes the total elapsed time based on the following jobs and idle time for machines. — 10 — M4 — CO2 CO3

JOP,							
	A	B	C	D	E	F	G
Machine M1	17	16	15	13	15	17	16
Machine M2	5	8	5	8	7	8	3
Machine M3	8	14	13	11	12	14	12

Find Min Total Elapsed time. Explain JIT principles in detail.

Q3A A company has one surplus truck in each of the cities A,B,C,D and E and one deficit truck in each of the cities 1,2,3,4,5 and 6. The distance between the cities in Km is shown in the matrix. Find assignment of truck from cities in surplus to cities in deficit so that total distance covered by vehicles is minimum . — 10 — M7 — CO2

Cities	1	2	3	4	5	6
A	14	12	18	21	17	18
B	12	20	21	19	21	16
C	13	12	19	12	15	14
D	8	16	13	18	12	14
E	10	14	12	17	19	11

Q3B		10	M7	CO1 CO2

Production facility Pi/ City demand Di	P1	P2	P3	P4	Product Demand
D1	23	25	19	29	27
D2	17	18	23	14	16
D3	25	15	28	18	20
D4	20	24	18	17	19
D5	26	19	25	20	12
Supply Capacity	21	16	25	32	94

Transportation Problem : A manufacturing company has four production plants P1,P2,P3,P4 with production capacity of 21, 16, 25, 32 (1000) liters per day of a product respectively.

These units are expected to be shipped to 5 cities D1,D2,D3,D4,D5 with requirements of 27, 16, 20, 19, 12 in (1000) liters per day respectively. The transportation cost in Rs per unit between factories and cities are given in table. Formulate LPP to Find the Min Cost of Transportation.Use NWCM to find initial basic solution to the transportation problem. Use LCM to find initial basic solution to the transportation problem. Find percentage reduction in transportation cost.

Q4A	Explain Monte Carlo simulation with illustrated example. Explain the various types of costs of inventory with graph.	10	M7, M3	CO1, CO2, CO3
Q4B	A manufacturer has 5 lathes and three milling machines which produces an assembly consisting of 2 units of part A and 3 units of part B. The processing time for each part on 2 types of machines is as follows.	10	M6, M2	CO1 CO2

Part	Processing time	
	Lathe	Milling
A	12	17
B	24	14

In order to maintain uniform work load on two types of machines, manufacturer follows the policy that no type of machine should run more than 40 min per day longer than other machine. Formulate LPP to produce maximum number of assembly in 8hrs of working day .

State the factors affecting the capacity of machine , Explore ways to eliminate these factors.

Q5A	Task A,B,C,.....H,I constitute a project. The precedence relationship is as follows A< D; A<E; B<F; D<F; C<G; C<H; F<I; G<I. Draw the project network, find project duration ,find critical path. Refer the following project data.	10	M5	CO1, CO3

Task:	A	B	C	D	E	F	G	H	I
Time:	11	13	10	13	20	19	20	16	12

Find E and L for each event. Find EST, LST,EFT,LFT float for each activity .

Differentiate between CPM and PERT

Q5B The time estimates in weeks for PERT network of project are as follows — 10 — M5 — CO1, CO3

Activity	to	tm	tp
1-2	1	3	9
1-3	2	7	9
1-4	3	9	10
2-5	2	4	7
3-5	3	7	16
4-6	3	8	10
5-6	5	9	17

Draw the project network, Find critical path
Compute the standard deviation and variance of the project length
What is the probability that the project will be completed atleast 2 week earlier than expected time

Q6A Derive an expression for Economic Order Quantity of the (Basic model) of inventory. State the purpose of keeping the inventory. — 10 — M3 — CO2, CO4

Q6B A company invests in advertisement in its 12 units.Advertise investment X and sales revenue Y is shown in table. Obtain a Line of Best Fit (regression line) for the data, and predict sales revenue of unit with $28 million in investment. All figures are in millions of dollars. — 10 — M1 — CO1, CO2

Units	**Advertise investment in Dollars (x)**	**Sales Revenue in Dollars (y)**
1	11	0.20
2	6	0.14
3	10	0.17
4	9	0.17
5	19	0.31
6	20	0.33
7	21	0.29
8	22	0.26
9	22	0.30
10	22	0.32
11	23	0.31
12	23	0.32

Explain Least Square method used in Sales/ Demand forecasting with the help of neat sketch.

Q7 Write Short Notes on — 20 — M1,M2, M3,M4 M5, M6 M7 — CO1 C

- Technologies used in MPC
- Techniques used in Materials Management
- Total Productive maintenance
- Principles of Lean Manufacturing

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PREVIOUS **End Semester Examination – DECEMBER 2022 Examinations**

Program: BTECH (MECHANICAL ENGG.) Sem VI
Course Code: PC-BTM606
Course Name: CAD /CAM/CIM

Duration: 3hrs
Maximum Points: 100
Semester: VI

28/12/22

Notes:

- Solve any five questions
- Figures to the right indicate full marks
- Assume suitable data wherever necessary

Q.No.	Questions	Points	CO	BL	PI
Q.1 (a)	Derive the transformation Matrix for rotation about arbitrary axis	[12]	1	1	3.2.1
(b)	Explain the properties of Bezier & Bspline curves with neat sketches	(08)	2,4	3	5.2.1
Q.2 (a)	Triangle PQR has vertices as P(2,4), Q (4,6) and R (2,6). it is desired to reflect through an arbitrary line L whose equation is y=0.5x+2. calculate the new vertices of the triangle.	[08]	2	3	3.2.1
(b)	Explain various Geometric modeling techniques in CAD, along with neat figures	[08]	1	1	3.2.1
(c)	Explain, With code & example the following A] Tool Length Compensation B] Tool Nose Radius Compensation	[04]	3	3	5.2.1
Q.3 (a)	Explain the concept of Reverse Engineering? Also explain CMM & its working with neat sketch? State the advantages & disadvantages of the same.	[12]	3	3	5.2.1
(b)	Write a short note on Computer Integrated Manufacturing (CIM)	[08]	2,3,4	1	3.2.1
Q.4 (a)	Explain 5 G-Codes & 5 M-Codes with example	[08]	4	3	5.2.1

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PREVIOUS **End Semester** Examination – DECEMBER 2022 Examinations

(b)	Explain the working principle of velocity & position feedback in CNC machines with neat sketches?	[12]	1	2	5.2.1
Q.5 (a)	Explain the following 1] Z-buffer Algorithm 2] Gourad Shading Algorithm	[10]	4	3	5.2.1
(b)	Write a C++ Program for 1] Bresanhams line and 2] Bresenhams Circle Algorithm	[10]	4	3	5.2.1
Q.6 (a)	Explain Computer Aided Process planning system with neat sketch?	[10]	1	2	5.2.1
(b)	Explain Group Technology with neat figures	[10]	1	2	5.2.1
7	Write Short Notes on (Any Three) • Object Oriented Databases (OODB) • Concurrent Engineering • Augmented Reality • Artificial Intelligence in Design • Graphics Standards • Structured Query Language (SQL)	[20]	3,4	2	5.2.1, 3.2.1

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PREVIOUS SEMESTER EXAMINATION DECEMBER 2022
EVEN SEMESTER COURSES

Program: T Y BTech. (Mechanical Engineering) **Duration: 3 Hours**
Course Code: PC-BTM 611 **Maximum Points: 100**
Course Name: COMPUTATIONAL METHODS **Semester: VI**

Notes:
- **Question no.1 is compulsory**. Answer any FOUR (04) from remaining six questions,
- Answers to all sub questions must be grouped together.
- Figures to the right of question statements are points, course outcome and question level as per Blooms taxonomy.
- Make any suitable assumption if needed with proper reasoning.

Q. No.		Points	CO	BL
1.	(A) Given the initial value problem $\frac{dy}{dx} = x + y, \quad y(0) = 0$. Find the value of y approximately for $x = 1$ by Euler method in five steps. Compare the result with the exact value which is given by $y = e^x - x - 1$	10	1	2
	(B) Explain predictor-corrector methods. Name any two method with their generic mathematical expression	10	1	4,1
2.	(A) A ball at 1200K is allowed to cool down in air at an ambient temperature of 300K. Assuming heat is lost only due to radiation, the differential equation for the temperature of the ball is given by $\frac{d\theta}{dt} = -2.2067 \times 10^{-12}\left(\theta^4 - 81 \times 10^8\right), \theta(0) = 1200K$ Find the temperature at $t = 480$ seconds using Runge-Kutta 4th order method.	12	2	3
	(B) A solid cube of dimension L is originally at a temperature T_0. The cube is then dropped into a large bath where the cube rapidly settles flat on the bottom. The fluid in the bath provides convective heat transfer coefficient h(W/in^{2}K) from the fluid at constant temperature T_∞. Analyze the case and answer following. (a) Develop a mathematical model to obtain transient temperature of cube with all significant assumptions. (b) List initial condition and show boundary condition with appropriate sketch. (c) Formulate for a numerical calculation and state the numerical techniques which can used to capture transient variation of cube temperature.	8	1	1,4,5
3.	(A) A chip of size A (face) is mounted on a substrate through an adhesive of thickness 1mm. The top surface is exposed to coolant flow at T_f and other side surfaces are insulated. The substrate is at constant temperature Ts. The thermal conductivity of adhesive, $k(T) = k_0 + 0.2T^2$. Develop a mathematical model to determine the time variation of chip temperature and its steady state temperature. List all reasonable assumptions.	12	2	4,1
	(B) Derive Simpson's 1/3rd Rule of numerical integration using the Lagrange interpolating polynomial.	8	1	3

4. **(A)** Solve the following system of equations using **12** 3 2,4

(a) Jacobi's iteration method, and

(b) Gauss-Seidel iteration method.

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

Formulate the problem for iterative solution of under both method and show the progress of solution till the convergence occurs with suitable convergence criterion.

(B) Use Newton-Raphson method to find root of $2\sin x = x$ **8** 1,2 3

5. **(A)** An outcome of experimental investigation is depicted in following table in the form of input variable and output f(x). **12** 2 2,3

x	1	3	4	5	7	10
f(x)	3	31	69	131	351	1011

(a) Construct Newton's forward divided difference table and develop interpolating polynomial.

(a) Predict maximum order of polynomial through the table of divided difference.

(b) Compare the values obtained from two quadratic polynomial using any two different data set of three, for f(4.5), f(8) and the second derivative of f(x) at x=3.2.

(B) Develop a mathematical model to estimate the variation of temperature of a cylindrical pin fin which convect heat to surrounding maintained at temperature Ta . Use distributed parameter model for analysis. **8** 1 4

6. **(A)** Compute the values of $I = \int_0^1 \frac{1}{1+x^2} dx$ correct to three decimal places. **12** 2 3,4

Solve it for Δx = 0.5, 0.25 and 0.125 using

(a) Trapezoidal method, and (b) 1/3 Simpson formula

(B) Solve following system of equation by LU decomposition

$$2x + 3y + z = 9$$
$$x + 2y + 3z = 6$$
$$3x + y + 2z = 8$$

Compare the result with Gauss Elimination and Matrix Inversion method. **8** 2 2

7. **(A)** Radiation intensity of a radioactive material is found to vary exponentially with time. Following table shows an experimental data recorder for radiation intensity and time involved. **12** 4 2

T (hrs)	0	1	3	5	7	9
γ	1.000	0.891	0.708	0.562	0.447	0.355

The relative intensity is related to time by the equation, $\gamma = Ae^{\lambda t}$

Find: a) The value of the regression constants,

b) Radiation intensity after 24 hours.

(B) What do you understand by well-conditioned system and ill conditioned system? Which parameters are used to recognize them? Illustrate with the help of an appropriate example. **8** 2 1

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B. Tech (C, M, E) Sem VI

PREVIOUS SEMESTER EXAMINATION – DECEMBER 2022 29/12/22

Program: B.Tech. in Civil/Electrical/Mechanical Engg. **Duration: 3 Hours**

Course Code: OE-BTM614 Sem VI **Max. Points: 100**

Course Name: Introduction to Optimization Methods **Semester: VI**

Notes:

1. Question no. 1 is compulsory. Solve any 4 of the remaining 6 questions.
2. Refer Annexures for additional information. Assume suitable data if necessary.

Q. No.	Questions	Points	CO	BL	Module
Q1 COMPULSORY	A) A snack food manufacturer markets two kinds of mixed nuts, labeled P and Q. Mixed nut P contains 10% almonds, 20% cashew nuts, 20% walnuts and 50% peanuts. Mixed nut Q contains 20% almonds, 10% cashew nuts, 30% watnuts and 40% peanuts. A customer wants to use mixed nuts P and Q to prepare a new mix that contains at least 3 kg of almonds, 6 kg of cashew nuts, 2 kg of walnuts, for a party. Mixed nuts A and B cost Rs. 800 and Rs.1000 per kg, respectively. **Formulate** the optimization problem to determine the amounts of mixed nuts P andQ to be used to prepare the new mix at a minimum cost. State design variables, objective function and constraints.	(5)	3	4	1
	B) It is required to minimize the following function using Box's evolutionary algorithm. $$f(x_1, x_2) = (x_1^2 + x_2 - 11)^2 + (x_1 + x_2^2 - 7)^2$$ Consider starting point $\bar{X}^{(0)} = \begin{Bmatrix} 1 \\ -1 \end{Bmatrix}$, size parameter $\Delta = \begin{Bmatrix} 1 \\ 1 \end{Bmatrix}$ and termination parameter $\varepsilon = 0.1$. Perform **one iteration** of the Box's evolutionary algortithm. What will happen if you choose Δ to be too small or too large?	(5)	3	4	4
	C) Give classification of integer programming problems. Why integer problems can not be solved as real-value problems? Explain the features of the full or exhaustive enumeration.	(5)	1	2	5
	D) What are non-traditional algorithms? List a few of these. Describe characteristics of evolutionary algorithms and explain their advantages over the other methods of optimization.	(5)	1	2	6

Q2	A) Consider a multivariate function $f(\bar{X})$ as given below. Develop an expression for $f(\bar{X}+\bar{d})$ in terms of Gradient and Hessian matrix of the function. $\bar{d}$ is a small arbitrary vector from $\bar{X}$. $$f(x_1,x_2) = 5x_1^2x_2 - 2\frac{x_1^2}{x_2}$$ Using the expression for $f(\bar{X}+\bar{d})$, explain how the nature of Hessian matrix can be used to determine maxima/minima of the function.	(5)	3	3	2
	B) Perform one iteration of bisection method to find maxima of function $f = x\sin x + \frac{x^2}{15}$ in the range (5,10). Consider x in degrees.	(5)	3	3	4
	C) Answer following questions related to Genetic Algorithm (GA). • Find length of the binary string to represent a variable up to 4 decimal accuracy in the range of 1 to 11. • The following table gives information about the population existing at a particular iteration of GA. **Sr. No. / Binary string of member / Fitness** 1 / 01010 / 85 2 / 10001 / 60 3 / 10100 / 40 4 / 11011 / 30 5 / 11110 / 10 The random number generated by the proportionate reproduction operator is 0.5. Which member will get selected? • For the population shown above, let member no. 3 and 4 be parents. Considering the position of crossover bit as 4, generate the offspring string. • Provide the new string if the offspring generated in the previous step is mutated at 2nd bit. • A Python code (partial) for implementing GA is provided in Annexure II. Analyze the code and answer the following. ○ In roulette wheel function, explain how and where (line numbers) the cumulative probability of each specimen is calculated. ○ Explain significance of code written in line numbers 41 and 42. ○ Explain significance of variable `p_mut` in line number 56. How it may be used in the subsequent hidden code to cause mutation?	(10)	2	4	6,7
Q3	A) Discuss the Karush-Kuhn-Tucker (KKT) optimality conditions for obtaining the stationary point for a general optimization problem.	(5)	1	2	2
	B) Describe the Simplex method using a detailed flowchart for the algorithm.	(5)	3	2	3
	C) Perform **two iterations** of Particle Swarm Optimization (PSO) algorithm to find the minima of following function in the range (2,4). Show detailed calculations for a typical case.	(10)	3	3	6

	$f(x) = x^2 + \frac{54}{x}$ • Use two particles with initial positions $x_1(0) = 2.5$ and $x_2(0) = 3.5$. • Inertial weight: $\theta = 1$ • Individual and group learning rates: $c_1 = c_2 = 2$ • Random number for individual particle, $r_1 = 0.5$ (both iterations) • Random number for group of particles, $r_2 = 0.3$ (both iterations)				
Q4	A) Describe the graphical method for optimization with a suitable illustrative example. Discuss the advantages and disadvantages of the method.	(5)	1	2	1
	B) There are certain computational aspects which are important during the implementation of optimization algorithms. Explain the importance of following aspects: (i) Information to be analyzed about the nature of problem before selecting a suitable software tool, (ii) Need of scaling the variables, (iii) Basis vector method to reduce size of problem.	(5)	2	2	7
	C) Explain the analogy between the physical process of annealing of metals and the process of optimization using Simulated Annealing (SA) algorithm. Describe the Metropolis criterion employed in SA. Consider an iteration of SA where the value of temperature is 500. The objective function values for two successive points x_1 and x_2 are 200 and 400 respectively. The random number generated to apply the Metropolis criterion is 0.1. Determine if x_1 would be accepted as an optimal point during this iteration.	(5)	3	3	5
	D) Explain the BBM algorithm for integer programming problems with a flowchart.	(5)	3	2	5
Q5	A) Minimize the following function using KKT method. $(x_1 - 5)^2 + (x_2 - 5)^2$ Subject to $x_1 + x_2 - 3 \leq 0$	(10)	3	3	2
	B) Perform **one iteration** of the basic random search algorithm to solve the following unconstrained optimization problem. $f(x_1, x_2) = (x_1 + 2x_2 - 7)^2 + (2x_1 + x_2 - 5)^2$ Identify the new initial point and the new range at the end of this iteration. Consider the following parameters: • Number of random samples per iteration = 3 • Initial point: $\bar{x}^0 = (2,1)$, Initial range: $\bar{z}^0 = (1, 1)$ • Range reduction factor: 0.3 • Generate random numbers using the scientific calculator.	(5)	3	3	4
	C) Describe different ways of classifying the optimization problems. Provide at least one example for each type of the problem.	(5)	1	2	1
Q6	A) Use Lagrange multiplier method to minimize: $f(x_1, x_2) = (x_1 - 2)^2 + (x_2 + 1)^2$ subject to $2x_1 + 3x_2 - 4 = 0$	(5)	3	3	2
	B) Perform **two iterations** of Simplex method to find the optimum solution for the following problem. *Minimize* $f(x_1, x_2) = -5x_1 - x_2$	(10)	3	3	3

	Subject to $2x_1 + x_2 \leq 1$ $-x_1 + 2x_2 \leq 2$ $x_1, x_2 \geq 0$ C) Describe the Golden section method of optimization with a suitable illustrative example.	**(5)**	1	2	4
Q7	A) What is a standard form of a linear programming (LP) problem? Explain significance of basic/non-basic variables and constants in the canonical form of the LP problem. How does one obtain the basic solution to a LP problem?	**(5)**	3	2	3
	B) Perform **one iteration** of unidirectional search using exhaustive search method to minimize following function. $f(x_1, x_2) = -8x_1 - 12x_2 + x_1^2 + 2x_1x_2 + x_2^2$ Consider starting point as $\begin{Bmatrix}0\\0\end{Bmatrix}$, search direction $\bar{s} = \begin{Bmatrix}1\\1\end{Bmatrix}$ and step size of 1. Give a recommendation for **selecting the search direction** at a given point.	**(8)**	3	3	4
	C) An optimization problem is defined as follows. Minimize $f(x_1, x_2) = (x_1 - 5)^2 + (x_2 - 5)^2$ Subject to $g_1(x_1, x_2): x_1 + x_2 - p \leq 0$ For p=5, optimal solution is $x_1^* = 2.5, x_2^* = 2.5$. Obtain the sensitivity of $f(x_1, x_2)$ with respect to p.	**(7)**	4	3	7

ANNEXURE I (Sensitivity equations using KKT formulation)

$$\frac{df(\bar{X})}{dp} = \frac{\partial f(\bar{X})}{\partial p} + \sum_{i=1}^{n} \frac{\partial f(\bar{X})}{\partial x_i} \frac{\partial x_i}{\partial p}$$

$$\begin{bmatrix} [P]_{n\times n} & [Q]_{n\times q} \\ [Q]_{q\times n}{}^{T} & [0]_{q\times q} \end{bmatrix} \begin{Bmatrix} \left.\frac{\partial x_i}{\partial p}\right|_{n\times 1} \\ \left.\frac{\partial \lambda_j}{\partial p}\right|_{q\times 1} \end{Bmatrix} + \begin{Bmatrix} [a]_{n\times 1} \\ [b]_{q\times 1} \end{Bmatrix} = \begin{Bmatrix} [0]_{n\times 1} \\ [0]_{q\times 1} \end{Bmatrix}$$

$P_{ik} = \frac{\partial^2 f(\bar{X})}{\partial x_i \partial x_j} + \sum_{j\in J_1} \lambda_j \frac{\partial^2 g_j(\bar{X})}{\partial x_i \partial x_k}$ $\quad J_1$ *is the set of active constraints*

$Q_{ij} = \frac{\partial g_j(\bar{X})}{\partial x_i}$ $\quad j \in J_1$

$a_i = \frac{\partial^2 f(\bar{X})}{\partial x_i \partial p} + \sum_{j\in J_1} \lambda_j \frac{\partial^2 g_j(\bar{X})}{\partial x_i \partial p}$ $\quad j \in J_1$

$b_j = \frac{\partial g_j(\bar{X})}{\partial p}$ $\quad j \in J_1$

ANNEXURE II: Genetic Algorithm (Partial Code)

```
def choice_by_roulette(sorted_population, fitness_sum):
    offset = 0
    normalized_fitness_sum = fitness_sum

    lowest_fitness = apply_function(sorted_population[0])
    draw = random.uniform(0, 1)

    accumulated = 0
    for individual in sorted_population:
        fitness = apply_function(individual) + offset
        probability = fitness / normalized_fitness_sum
        accumulated += probability

        if draw <= accumulated:
            return individual

def crossover(individual_a, individual_b):
    maxbits=11 # accommodate (-6.00,+6.00) with 2 decimal accuracy

    xa = individual_a["x"]
    ya = individual_a["y"]
    xb = individual_b["x"]
    yb = individual_b["y"]
    #convert real numbers with 2 decimals
    xa_bin = convert_real_to_binary_list(xa,maxbits)
    ya_bin = convert_real_to_binary_list(ya,maxbits)
    xb_bin = convert_real_to_binary_list(xb,maxbits)
    yb_bin = convert_real_to_binary_list(yb,maxbits)
```

```
29
30      # generating the random number to perform crossover
31      k = random.randint(1, maxbits)
32      # interchanging the genes
33      for i in range(k, maxbits):
34          xa_bin[i] = xb_bin[i]
35      # generating the random number to perform crossover
36      k = random.randint(1, maxbits)
37      # interchanging the genes
38      for i in range(k, maxbits):
39          ya_bin[i] = yb_bin[i]
40
41      x_new = int("".join(str(i) for i in xa_bin),2)/100.0
42      y_new = int("".join(str(i) for i in ya_bin),2)/100.0
43
44      return {"x": x_new, "y": y_new}
45
46  def mutate(individual):
47      maxbits=11
48
49      x = individual["x"]
50      y = individual["y"]
51
52      #convert real numbers with 2 decimals
53      x_bin = convert_real_to_binary_list(x,maxbits)
54      y_bin = convert_real_to_binary_list(y,maxbits)
55
56      p_mut=0.005 # probability of mutation
57
58       >>> code hidden <<<
59
60      next_x = int("".join(str(i) for i in x_bin),2)/100.0
61      next_y = int("".join(str(i) for i in y_bin),2)/100.0
62      lower_boundary, upper_boundary = (-6, 6)
63      # Guarantee we keep inside boundaries
64      next_x = min(max(next_x, lower_boundary), upper_boundary)
65      next_y = min(max(next_y, lower_boundary), upper_boundary)
66      return {"x": next_x, "y": next_y}
```

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PREVIOUS SEM END SEMESTER EXAMINATION, DECEMBER-2022

T.Y. B.Tech (ME) Sem VI 30/12/22

Program: **B. Tech. in Mechanical Engineering** Date: **30/12/2022**

Class: **Third Year B. Tech. (Mechanical)** Duration: **3 Hr.**

Course code: **PEC-BTM 538** Max. Points: **100**

Course: **Industrial Management and Enterpreneurship** Semester: **VI**

Instructions:

- Attempt **ANY 05** questions.
- Draw neat diagram /Sketch/Block Diagram wherever necessary.
- Use **Graph paper** for drwaing Break-Even Chart
- **Legible hand writting**, proper figures and tidy work carry weightage.
- Answers to the questions should be **Brief and Specific.**

Q. N.	Question	Points	CO	Module	BL	PI
1	A) **Discuss:** *'Is Management a science or an art?'* **Explain:** Functions of a Manager in an organisation.	(10)	1	1	II, V	9.1.1
	B) **Differentiate:** Between Management and Administration. **Explain:** Process of management in an organisation.	(10)	1	1	II	9.1.1
2.	A) **Explain:** Motivation, Types and Techniques of motivation. **Illustrate:** With suitable example of practice in specific industry.	(10)	1	2	II, V	9.1.1
	B) **Explain:** Scope and importance of Human Resource Management in various functional areas of an organization. **Illustrate:** With suitable examples.	(10)	1	2	II, V	9.1.1
3.	A) **Explain:** '*Break-Even Analysis is as an effective managerial tool in an organisation'*. **Describe:** assumptions and limitations in break-even analysis.	(10)	2	3	II, III	9.1.1
	B) **Explain:** Difference between Cost Control and Cost Reduction. **Describe:** Techniques for Cost Control and Programmes for Cost Reeduction in an organisation.	(10)	2	3	II	9.1.1
4	A) **Explain:** Significance, sources and uses of Fixed Capital and Working Capital for an industrial organisation.	(10)	2	4	II	9.1.1
	B) **Explain:** Meaning, significance and types of assets and liabilities of an industrial organisation with suitable examples.	(10)	2	4	II	9.1.1
5	A) **Define:** Enterpreneurship. **Explain:** How '*An enterpreneur differs from a Manager?*' by describing entrepreneurial characteristics.	(10)	3	5	I,II	9.1.1
	B) **Explain:** Need for promotion of enterpreneurship and small business especially in country like India.	(10)	3	5,6	II	9.1.1
6	A) **Explain:** Functional areas of a small business enterprise in details.	(10)	3	6	II	9.1.1
	B) **Explain:** Tangible and intangible benefits of implememtation of ERP in industry.	(10)	4	7	II	9.1.1

7	**Expalin: ANY THREE** of the following in brief: A) Principles of Management B) Maslow's Hierarchy of Needs Theory C) Types of Cost D) Financial Statements of an organization E) ERP-II	(20)	1,2 4	1,2 3,4 7	II	9.1.1

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Previous Year End Semester - December 2022 Examinations

20/12/22

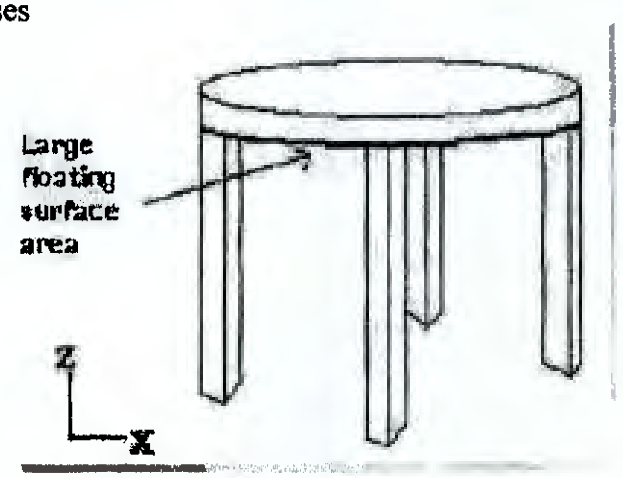
Program: T.Y.B. Tech. (Mech. Engg.) Sem VI **Duration: 03 Hrs**

Course Code: PE-BTM539 **Maximum Points: 100**

Course Name: Professional Elective-II, Additive Manufacturing **Semester: VI**

Notes:

1. **Question number 1 is compulsory**
2. **Solve any four questions from question number 4 to 7.**
3. **If necessary assume suitable data with justification**
4. **Draw neat labeled sketches wherever required.**

Q. No.	Questions	Points	CO	BL	M.N.
1	Part shown below is to be develop using following RP processes  (i) Bulk Lithography (ii) Laminated Object Manufacturing (iii) Selective Inhibition Sintering Part is to be developed using compatible material for above mentioned processes. State (i) Compatible materials for the above processes. (ii) Part orientation in developing part with above processes. (iii) Explain process plan with neat schematic diagram of above processes iv) Support process plan with at least three critical sliced sections of part geometry (Note: Answer shall clearly show slicing place, sliced geometry, hatched section etc.).	20	1, 2,3,4	6	1 to 7
2 (A)	Describe extrusion based RP systems. Discuss Fused deposition modeling (FDM) process with a neat labeled diagram.	10	3	6	3,4

	Discuss various sub-systems of FDM. In one of the FDM system issues in linear scan speeds is observed due to error in software program. On investigation it is observed that X scan speed is optimum, however the Y scan (in the direction of pitch) is twice the optimum speed. Explain consequences in part fabrication. Further in case if Y scan speed would have been optimum and X scan speed being twice the optimum X scan speed, comment in which case part quality would be worst.				
2 (B)	Explain mathematical form of cured depth in ceramic or metal microstereolithograhy along with Mie theory. Explain influence of followings material properties on curing radius and cured depth i) Particle mean size ii) Particle size distribution iii) Refractive index of powder iv) Refractive index of UV curable solution v) Absorption coefficient of powder (Note: Draw rough graphs with curing radius and cured depth taken on y-axis on common graph depicting influence of materials properties. Material properties shall be on x-axis. Justify each of the characteristics).	10	1	4	3,5
3 (A)	Explain stereolithography with neat sketches	10	2	5	3,4,5
3 (B)	With neat sketches explain constraint surface microstereolithography (MSL)? Discuss advantages and issues with constraint surface MSL.	10	1	1	3,4,5
4 (A)	Following are the system and material property data employed for part fabrication in a scanning type Bulk Lithography system. Resin: Trimethylolpropane Triacylate (TMTPA), having critical energy 60 mJ/cm^2, penetration depth = 90 microns when exposed to UV light. Laser beam power=150 microwatt, Scan speed=0.7 mm/s, Gaussian half widh=6 microns, For Gaussian beam laser estimate the maximum layer thickness that can be used in layer-by-layer fabrication. Also estimate the maximum intensity at the exposure resin surface and at a distance 80 microns below free resin surface.	10	3	2	4,5
4 (B)	With neat diagram explain Laser Engineered Net Shaping process	10	1	3	5,6
5(A)	With neat sketches explain processes used to fabricate microlens arrays	10	4	4	6,7

5(B)	With neat sketch explain shape deposition manufacturing process. Take suitable part geometry to explain processes involved in shape deposition manufacturing.	10	2	4	6,7
6(A)	Explain AM process plan with neat diagram	10	1	4	1
6(B)	Explain steps suggested by Mueller for selecting the proper type of material for additive manufacturing.	10	3	3	1,2
7(A)	Explain .stl and amf file format and its importance.	10	2	1	1,2
7(B)	What is amorphous material? Discuss its behavior on volume against Temperature diagram. List few amorphous materials used in RPT.	10	3	2	1,2

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PREVIOUS SEMESTER EXAMINATION DECEMBER 2022

Program: B.Tech Mechanical Engineering **Duration: 3 Hours**

Course Code: PCBTM611 **Maximum Points:100**

Course Name: Refrigeration and Air Conditioning **Semester: VI**

Notes:

1) **Question no.1 is compulsory and solve any four questions out of remaining six.**
2) **Use of refrigerant properties and psychrometric chart is permitted.**
3) **Use of steam table is permitted.**
4) **Assume suitable data and justify the same.**
5) **Answers to sub-questions should be grouped together.**

Q.No.	Questions	Points	CO	BL	Module No.
1(a)	Draw comfort chart and compare it with psychrometric chart.	5	3	1	6
1(b)	Compare primary refrigerants and secondary refrigerants.	5	3	1	2
1(c)	Show that coefficient of performance of refrigeration cycle working between two temperatures will be maximum when cycle is reversible.	5	1	1	1
1(d)	Define terms: (i) Humidity ratio (ii) Relative Humidity (iii) Degree of saturation (iv) Dew point temperature	5	3	1	3
2(a)	Explain actual vapour compression cycle with neat sketch of T-s and P-h diagram.	8	1	1	1
2(b)	An R-134a simple saturation cycle refrigerator operates at 40°C condenser and -16°C evaporator temperatures. Determine COP and HP/TR. If a liquid –vapour regenerative heat exchanger is installed in the system, with the suction vapour at 15°C, calculate the change in COP and HP/TR.	12	2	3	1
3(a)	Explain the process of measuring wet bulb temperature of air. Also discuss how wet bulb temperature which is not a thermodynamic property can be considered as thermodynamic property.	10	3	2	3

PREVIOUS SEMESTER EXAMINATION DECEMBER 2022

3(b)	Explain complete designation system of refrigerants.	10	2	2	2
4(a)	Explain Boot-strap air refrigeration cycle with T-s and schematic diagram.	10	1	2	1
4(b)	The DBT and WBT of the air are 35°C and 23°C respectively. Find the followings if total air pressure is 1.00125 bar. Calculate following without using psychrometric chart. (i) Specific humidity (ii) Relative humidity (iii) DPT (iv) density (iv) Enthalpy.	10	2	3	3
5	A building has the following calculated cooling loads: Room sensible heat gain = 310 kW Room latent heat gain = 100 kW The space is maintained at DBT of 25°C and relative humidity of 50 %. The outdoor air is at 38°C and 50% R.H. And 15 % by mass of air supplied to the building is outdoor air. If the air supplied to the space is not at temperature lower than 18°C. Find (i) Minimum amount of air supplied to space in m^3/s. (ii) Volume flow rates of return air and outdoor air (iii) State and volume flow rate of air entering the cooling coil. (iv) Capacity, ADP, BPF and SHF of the cooling coil.	20	4	3	4
6(a)	Discuss mechanism of body heat loss and explain mathematical model of heat exchange between man and environment.	10	3	2	5
6(b)	Explain various types of duct design methods.	10	3	2	6
7(a)	What is three fluid refrigeration system? Explain it with neat sketch.	10	3	2	7
7(b)	Explain working of practical single effect water-lithium bromide absorption chiller with neat sketch.	10	3	2	7

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PREVIOUS SEM END SEMESTER EXAMINATION, DECEMBER-2022

Program: **B. Tech. in Mechanical Engineering**
Class: **Third Year B. Tech. (Mechanical)** Sem VI
Course code: **PCC-BTM 614**
Course: **Internal Combustion Engines**

Date: **03/01/2023**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VI**

3/1/23

Instructions:

- **Solve ANY O5 Questions.**
- Draw neat diagram /Sketch wherever necessary.
- **Make suitable assumptions** wherever necessary and **state the same.**
- **Legible hand writting,** neat diagrams and tidy work carry weightage.
- Answers to the questions should be **Brief and Specific.**

Q. N.	Question	Points	CO	Module	BL	PI
1.	A) **Discuss:** Classification of I.C. Engines. **Explain:** Working of a four-stroke petrol engine with a neat sketch.	(10)	1	1	I,II	1.4.1
	B) **Compare:** S.I. and C.I. Engines on the basis of thermodynamic cycle, compression ratio, fuel used, introduction / injection of fuel and combustion of fuel. **Draw:** Neat sketches wherever necessary.	(10)	1	1,3	I,II	1.4.1
2.	A) **Describe:** Phenomenon of combustion in S.I. Engines. **Draw:** Neat p-θ diagram. **Explain:** Each stage of combustion.	(10)	3	2	I,II	1.4.1
	B) **Explain:** Working of a simple or elementary carburettor. Draw: Neat sketch. A simple jet carburettor has to supply 5 kg of air per minute. The air is at a pressure of 1.013 bar and temperature of 27°C. **Calculate:** The throat diameter of the choke for air flow velocity of 90 m/s. Take velocity co-efficient as 0.8. Assume the flow to be isentropic and compressible.	(10)	1,2	2	I,II V	1.4.1
3.	A) **State:** Types of fuel injection system for C.I. Engines. **Describe:** Working, advantages and disadvantages of any one fuel injection system with neat sketch.	(10)	1,4	3	I,II	1.4.1
	B) **Explain:** i) Delay period ii) Diesel knock. An air standard diesel cycle has a compression ratio of 14. The pressure and temperature at the beginning of the compression stroke is 1 bar and 27°C. The maximum temperature in the engine during the cycle is 2500°C. **Evaluate:** i) Thermal efficiency and ii) mean effective pressure.	(10)	2,3	3	II, V	1.4.1
4.	A) **Explain:** Necessity and methods of Supercharging of an I.C. Engine. **Discuss:** Effect of supercharging on performance of I.C. Engines. **Draw:** Neat sketches wherever necessary.	(10)	2,4	4	I,II	1.4.I
	B) The following data is recorded from the performance testing of a single cylinder four stroke oil engine: Cylinder bore = 150 mm, engine stoke = 250 mm, indicated mean effective pressure = 7.5 bar, engine speed = 420 rpm, brake torque = 217 m.N, fuel consumption	(10)	2	4	V	1.4.I

	= 2.95 kg/hr, calorific value of fuel = 44000 kJ/kg, colling water flow rate = 0.068 kg/s, cooling water temperature rise = 45°C, specific heat capacity of cooling water = 4.1868 kJ/kg.K. **Evaluate:** i) Mechanical efficiency ii) brake thermal efficiency iii) specific fuel consumption. **Estimate:** Heat balance for the engine in kW.					
5.	A) **Discuss:** Sources and pollutants from I.C. Engines and their adverse effects on human life.	(07)	3	5,7	II	1.4.1
	B) **Justify:** Four stroke engines are more fuel economic and environment friendly as compared to Two stroke engines. **Justify:** Necessity of flue gas analysis of an I.C. Engine.	(07)	3	1,5	V	1.4.1
	C) **Explain:** Significant properties of fuel for use in S.I. Engine. **Justify:** *Fuels for S.I. engines and C.I. engines are not interchangeable for their use in I.C. Engines.*	(06)	3	5	II, V	1.4.1
6.	A) **State:** Various types of Engine Cooling System and **Compare:** The advantages and disadvantages of air cooling and water cooling of I.C. Engines. **Explain:** Working of forced circulation engine cooling system with a neat diagram.	(10)	1,4	6	I,II	1.4.1
	B) **Justify:** Necessity of lubrication and **State:** Various lubrication systems for I.C. Engines. **Describe:** Any one engine lubrication system with a neat sketch.	(10)	1,4	6	I,II V	1.4.1
7.	**Explain: ANY THREE** of the following in brief: A) Advantages and Disadvantages of Two-Stroke Engines B) MPFI C) Types of nozzles for C.I. Engines D) Performance Characteristics of S.I. Engines E) Biofuels for I.C. Engines	(20)	1,3 4	1,2 3 4,7	II	1.4.1