Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI

DEPARTMENT OF MECHANICAL ENGINEERING

END SEMESTER EXAMINATION, JUNE 2023

PROGRAM: Final B.Tech. (Mechanical), Semester-VI
COURSE: OE-BTM611- Computational Methods

T.Y. B.Tech (Mech) - Sem-VI

Total Points: 100
Duration: 3 HOURS

Note:

- Answer any 5 questions out of 7 questions. Each question carries 20 points,
- Answer should be very specific and to the point,
- Make suitable assumptions if needed,
- Answer of all sub-questions must be grouped together in answer book.
- Data in the last column represents course outcome and Blooms Taxonomy of respective question.

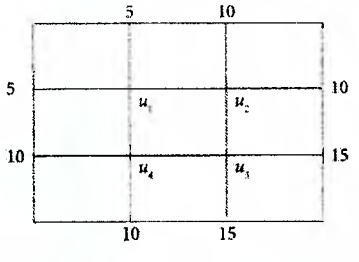
Q1. What is the need of numerical integration in the engineering applications? What do you understand by Newton Cotes Quadrature formula? Suggest any three popular methods under this class. Which method can give most accurate approximation. Evaluate the integral $\int_1^2 \sqrt{1+cos^2 x}\,dx$ with help of Trapezoidal and Simpson 1/3 rule with spacing h=0.1 — **20** — CO/BL: 2/3,4

Q2. Differentiate between Interpolation and Regression. — **20** — 1,2/1,3
Following are the census details of the population of India from the year 1961 to 2011. Fit an exponential curve, $y=ae^{bx}$ to these data, and hence find the approximate population in the year 1966, 1985, 1996 and 2009.

Year (x)	1961	1971	1981	1991	2001	2011
α(mm)/°C	43.9235	54.8160	68.3329	84.6421	102.8737	121.0193

Is the current regression model for the given data is appropriate? Suggest an alternative regression model.

Q3. Consider following partial difference equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$. Use second order finite difference equation to find the unknown values u_1, u_2, u_3, and u_4, Use Gauss Seidel method for the solution. — **20** — 2,3/1,4



Q4. Differentiate between IVP and BVP with real life example. Name single step and multi-step method (2 methods for each). — **20** — 1,2,3 /1,2,3

Solve the first order ordinary differential equation $\frac{dy}{dt}=y-3t^2$ subject to initial condition $y(0)=1$. Use RK4 with a step size of $h=0.1$ and obtain the solution till $t=0.5$ in tabular for with details of steps of calculation.
Discuss the error by comparing the numerical solution with the exact solution given by $y_{exact}=3t^2+6t+6-5e^t$.

Q5. What do you understand by mathematical modelling and numerical modelling? Explain your understanding with appropriate and sufficient examples. **20** 1,3 /1,3,4

A researcher performed an experiment in his laboratory and obtained following data represented in the able where he changed the input (x). Using data, construct a Lagrange polynomial and a Newton's divided difference polynomial of second order. Calculate f(3) under both methods.
Comment on the order of polynomial possible with the available data.

x	0	1	2	4	5	6
f(x)	1	14	15	5	6	19

Q6. What do understand by a system of ill-conditioned system? Suggest a technique to ill-condition problem. **20** 1,2,3 /3,4

Solve the following system of equations correct to two decimal places.

$$3.1x_1 + 9.4x_2 - 1.5x_3 = 22.9$$

$$2.1x_1 - 1.5x_2 + 8.4x_3 = 28.8$$

$$6.7x_1 + 1.1x_2 + 2.2x_3 = 20.5$$

Use following methods to formulate and compare the result,

a. Gauss–Seidel method
b. SUR with relaxation factor = 0.7

Show result in tabular form for minimum six iterations.

Q7. During modelling an engineering system, following transcendental equation emerges- **20** 1,2/3,4

$$xe^x - 2 = 0$$

Solve for one of the roots of the equation by the secant method and compare the result with Newton Raphson method.
Tabulate the result, observe it and analyse. Which method gives faster convergence?

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

Endsem June 2023 Examinations

9/6/23

Program: B.Tech Civil/Mechanical/Electrical | **Duration: 3 Hrs.**
Course Code: OE-BTM613 | **Maximum Points: 100**

Course Name: Entrepreneurship Development & Start-Up | **Semester: VI**

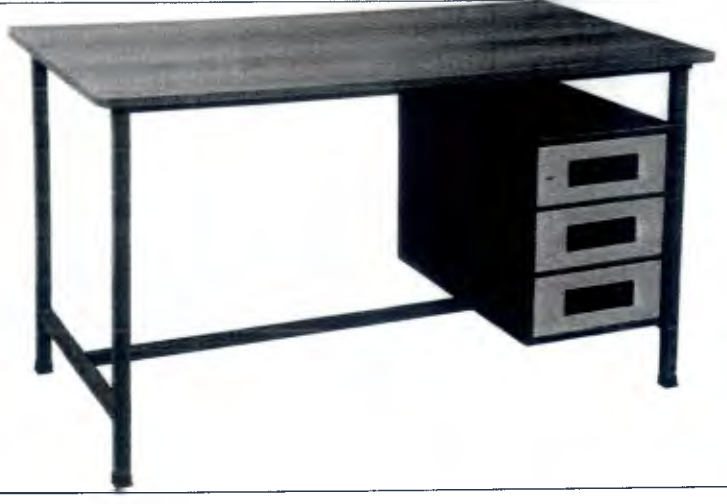
T.Y.B.Tech {Civil / Mech / Elec} - Sem-VI

Notes:

1. Question 1 is Compulsory.
2. Answer **any 4** out of the **remaining 6** questions.

Q. No.	Questions	Points	CO/ MO	BL
1 a	List Different Qualities of Entrepreneurs?	04	01/ 01	01
1 b	What is Scamper? Give one example each of this idea generation technique.	04	02/ 02	01
1 c	Describe Desk Research Method of Marketing Research Method?	04	02/ 03	02
1 d	You want to reuse plastic bottles instead of throwing it. Generate any 4 ideas and create a sketch showing reuse of plastic bottles?	04	03/ 04	06
1 e	Give classification of Intellectual Property Rights?	04	04/ 05	04
2 a	Explain Democratic and Transactional type of leadership styles?	08	01/ 01	02
2 b	For the 4 ideas developed for plastic bottle reuse in previous question, evaluate the ideas based on Time, Cost, Resource Availability, Market Demand, Funding. Use Evaluation Matrix method and rank the ideas based on the ratings.	08	02/ 02	05
2 c	What are different sampling techniques?	04	02/ 03	01

3 a	Give the flow chart for prototyping process?	04	02/ 04	01
3 b	Describe role of PCT in Intellectual Property rights? Show its application process with help of flow chart.	08	04/ 05	02
3 c	What is the role of Incubation centers in institutional support to start-ups.	08	04/ 07	01
4 a	Give the Classification of Prototypes and show different examples of prototypes in each quadrant.	08	03/ 04	04
4 b	What are the contents of a Feasibility Report?	08	04/ 06	01
4 c	Differentiate between Innovation and Invention	04	02/ 02	02
5 a	Explain the procedure of market research and write its limitations?	08	02/ 03	02
5 b	Recommend various Technical Considerations for Techno-Economy Analysis?	08	04/ 06	05
5 c	Classify Micro Small and Medium Enterprises.	04	04/ 07	04
6 a	Give Arthur Cole Classification of Entrepreneurs?	06	01/ 01	04
6 b	Given is the figure of Office Table. Generate at least 7 ideas on how to make this table technologically advance. Draw sketch of ideas on the given table. Show its features too.	14	03/ 02	06



7 a	Identify which IPR category below items fall in and give justification for your answer: i. Rich Dad Poor Dad Book ii. BMW Car Shape and Design iii. Coke's Coca Cola iv. Jalgaon Banana v. Nike Logo	10	04/ 05	1,5
7 b	Describe NSIC and state its functions?	10	04/ 07	2

****

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

END SEMESTER EXAMINATION - JUNE 2023

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

Course Code: OE-BTM614 **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. Assume suitable data if necessary.
3. *'a'* is the single last digit (0 to 9) of the student's registration number in questions marked with *.

Q. No.	Questions	Points	CO	BL	Mod. No.
Q1 COMPULSORY	A) A manufacturer sells products P1 and P2. Profits from P1 is ₹1000/kg and from P2 is ₹800/kg. Available raw materials for the products are: 200 kg of M1 and 250 kg of M2. To produce 1 kg of P1, 0.2 kg of M1 and 0.6 kg of M2 are needed. To produce 1 kg of P2, 0.5 kg of M1 and 0.2 kg of M2 are needed. The maximum demand for the products is 400 kg for P1 and 300 kg for P2. How much of P1 and P2 should be produced to maximize profit? **Formulate** the optimization problem in the standard form.	**(5)**	3	4	1
	B) * Briefly discuss the significance of gradient vector and Hessian matrix in the calculus-based methods. Obtain the gradient vector and Hessian matrix for the following function at (1,1). $f(x_1, x_2) = (10 - \boldsymbol{a})x_1x_2 + 3x_1^2x_2^4 + (5 + \boldsymbol{a})x_2$	**(5)**	3	3	2
	C) Explain the procedure of Simplex method with a flowchart for the method.	**(5)**	3	2	3
	D) Give feature wise comparison between the following optimization algorithms **strictly in table form** (with column for each algorithm): Box's algorithm, Genetic algorithm, Particle Swarm Optimization.	**(5)**	1	3	6
Q2	A) * Perform **two iterations** of the Simplex method to find the optimum solution for the following problem. $Maximize\ f(x_1, x_2) = 3x_1 + 5x_2$ $Subject\ to$ $(5 + \boldsymbol{a})x_1 + 3x_2 \leq 20$ $7x_1 - (2 + \boldsymbol{a})x_2 \geq -5$ $x_1, x_2 \geq 0$	**(10)**	1	3	3
	B) Perform **one iteration** of the basic random search algorithm to minimize the following objective function. $f(x_1, x_2) = 3(x_1 - 3)^2 + 5(x_2 - 5)^2$ • Number of random samples per iteration = 3 • Generate random numbers using scientific calculator • Initial point: $\bar{x}^0$ = (1,1), Initial range: $\bar{z}^0$ = (2, 2) • Range reduction factor = 0.2	**(5)**	3	3	4
	C) Define the integer programming problem in its standard form. What are the different types of integer programming problems based on the nature of variables? Discuss if we can ignore the integer constraints and later round-off the obtained real value solution.	**(5)**	1	2	5

Q3	A) * Apply bisection method to complete **one iteration** to find the minima of following function in the range (10,15). **Use a numerical method** (such as central difference method) to calculate the gradient. $f(x) = 5 + (x - 13 - 0.1 \times a)^2$	(5)	3	3	4
	B) Solve the optimization problem in Q1(A) using graphical method.	(5)	1	3	1
	C) * Minimize the following function using KKT method. $\frac{(x_1 - 20)^2}{(1 + a)} + \frac{(x_2 - 20)^2}{(10 - a)}$ Subject to $x_1 + x_2 \leq (a + 10)$	(10)	3	3	2
Q4	A) State the linear programming (LP) problem in a standard form and define following terms which appear in the canonical form of a LP problem: basic variables, non-basic variables, and constants. Describe the simple algebraic method to obtain the basic solution to an LP problem. What is the advantage of Simplex method over this method?	(5)	3	2	3
	B) Perform **two iterations** of Particle Swarm Optimization (PSO) algorithm to find the minima of following function. Show detailed calculations. $f(x) = 5 + (x - 13)^2$ • Use two particles with initial positions $x_1(0) = 11$ and $x_2(0) = 14$. • Inertial weight $\theta = 0.8$ • Individual and group learning rates: $c_1 = c_2 = 1.5$ • For first iteration (both particles): $r_1 = 0.3, r_2 = 0.8$ • For second iteration (both particles): $r_1 = 0.8, r_2 = 0.3$	(10)	3	3	6
	C) Explain the following computational aspects during an optimization process: (i) Scaling the variables, (ii) Reduced basis technique, (iii) Selection of a suitable software tool for a problem.	(5)	2	2	7
Q5	A) An integer programming problem is defined as follows. Maximize $f = 3x_1 + 5x_2$ Subject to $2x_1 + 7x_2 \leq 100$ $5x_1 - 7x_2 \leq 65$ $x_1, x_2 \geq 0$, integers • Find initial real value solution using graphical method. • Develop the first branch of BBM based on x_1 and find real value solution using graphical method for the child node having smaller numerical value. • Based on your result for the child node, mention further step with proper reasoning based on the BBM algorithm.	(10)	2	3	5
	B) Illustrate Lagrange Multiplier method for optimization with the help of a suitable example.	(5)	1	2	2
	C) Discuss the different types of optimization problems encountered in engineering. Provide one example of each type.	(5)	1	2	1
Q6	A) An optimization problem is defined as follows. Minimize $f(x_1, x_2) = (x_1 - 10)^2 + (x_2 - 10)^2$ Subject to $g_1(x_1, x_2)$: $x_1 + x_2 - p \leq 0$ For p=10, optimal solution is $x_1^* = 5, x_2^* = 5$. Obtain the sensitivity of $f(x_1, x_2)$ with respect to p.	(10)	2	3	7

	B) * Answer following questions related to Genetic Algorithm (GA). • Find length of the binary string to represent a variable up to 2 decimal accuracy in the range of 1 to (10+***a***). • The following table gives information about the population existing at a particular iteration of GA. **Sr. No.** | **Binary string of member** | **Fitness** 1 | 11111 | 90+***a*** 2 | 11110 | 70+***a*** 3 | 11100 | 40+***a*** 4 | 11001 | 20+***a*** 5 | 10110 | 5+***a*** The random number generated by the proportionate reproduction operator is (0.2+0.045****a***). Which member will get selected? • For the population shown above, let member no. 4 and 5 be parents. Considering the position of crossover bit as 2, generate the offspring strings. • Provide the new string if the offspring generated in the previous step is mutated at 3rd bit.	**(5)**	2	3	6
	C) * Apply exhaustive search method to complete **three iterations** to find the minima of following function in the range (10,15). Consider 5 steps within the total interval. $f(x) = 5 + (x - 13 - 0.1 \times a)^2$	**(5)**	3	3	4
Q7	A) Describe the Karush-Kuhn-Tucker (KKT) optimality conditions for handling a general optimization problem. What are the limitations of this method?	**(5)**	1	2	2
	B) Compare the features of deterministic and stochastic algorithms for optimization. Support your comparison with an appropriate example from each type of algorithm.	**(5)**	1	2	1
	C) * During an iteration of Simulated Annealing (SA) run, the objective function values for two successive points x_1 and x_2 are 100 and (120+***a***). The temperature value during these calculations is 100. The random number generated to apply the Metropolis criterion is (0.4+0.5****a***). Determine whether x_2 would be accepted by the algorithm as an optimum point? A python code for implementing SA for optimization is given in Annexure II. Answer the following questions after reviewing the code. • Find out the mathematical function which is used to define the cooling schedule. State the corresponding line number. • Locate the code (line numbers) for implementing the Metropolis criterion. • What will be the effect of increasing the values of variable n on the performance of the code?	**(5)**	2	4	5
	D) Explain the particle swarm optimization (PSO) algorithm with neat flowchart.	**(5)**	3	2	6

ANNEXURE I (Sensitivity equations using KKT formulation)

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

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

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

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

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

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

ANNEXURE II: Simulated Annealing Algorithm (Partial Code)

```
def f(x):
 # code trimmed
 return val

def constraints_okay(x1,x2):
 # code trimmed
 return val

###### Number of cooling steps
n = 50
###### Number of trials per cooling step (t_max)
t_max = 5
###### Initial temperature
Tmax=100
###### Final temperature
Tmin=0.1
###### Start location
x_start = [-9, -5]
###### allowable integer increments for x1 and x2
xint=list(range(-10,11,1))
# Initialize x
x = np.zeros((n+1,2))
x[0] = x_start

xi = np.zeros(2)
xi = x_start

# Current best results so far
xc = np.zeros(2)
xc = x[0]
fc = f(xc)
fs = np.zeros(n+1)
fs[0] = fc
# Current temperature
t = Tmax

for i in range(n):
```

```
38    #print('Cycle: ' + str(i) + ' with Temperature: ' + str(t))
39    for j in range(t_max):
40      # Generate new trial points
41      pointsokay=False
42      while not pointsokay:
43        x1temp= xc[0]+random.choice(xint)
44        x2temp= xc[1]+random.choice(xint)
45        if constraints_okay(x1temp,x2temp):
46          pointsokay=True
47          xi[0]=x1temp
48          xi[1]=x2temp
49
50      DeltaE = abs(f(xi)-fc)
51      if (f(xi)>fc):
52          # objective function is worse
53          # generate probability of acceptance
54          p = math.exp(-DeltaE/t)
55          # determine whether to accept worse point
56          if (random.random()<p):
57              # accept the worse solution
58              accept = True
59          else:
60              # don't accept the worse solution
61              accept = False
62      else:
63          # objective function is lower, automatically accept
64          accept = True
65      if (accept==True):
66          # update currently accepted solution
67          xc[0] = xi[0]
68          xc[1] = xi[1]
69          fc = f(xc)
70    # Record the best x values at the end of every cycle
71    x[i+1,0] = xc[0]
72    x[i+1,1] = xc[1]
73    fs[i+1] = fc
74    # Lower the temperature for next cycle
75    # Fractional reduction every cycle
76    frac = (Tmin/Tmax)**(1.0/(n-1.0))
77    t = frac * t
78    print('Cooling step: ' + str(i) + ' with Temperature: %5.2f'%(t),
79          ' Accepted current solution: (',xc[0],',',xc[1],'),  obj.func. = ',fc)
80
81  print('Best solution: ' + str(xc))
```

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

END SEM EXAM JUNE 2023	
DATE :12-06-2023	**SESSION: MORNING**
Class : Third Year B.Tech.in Mechanical Engineering	**Semester : VII**
Course Name: Manufacturing Planning and Control	**PC-BTM605**
Total Points 100	**Time Allotted : 3hour**

NB. T.Y.B.Tech (Mech) Sem- VI 11/6/23

1. **Que 1 is compulsory**
2. **Solve any 4 questions from remaining.**
3. **Assume Suitable Data wherever required**

QN	Question Statement	Points	Module	CO
Q1A	A project has following data.	10	M5	CO1, CO2 CO3

Activity	Immediate Predecessor	Duration
A	-	6
B	-	4
C	A,B	9
D	B	5
E	A	7
F	C	5
G	E,F	4
H	D,F	5
I	G,H	9
J	I	5

i. Draw Project Network.
ii. Find Duration
iii. Find all paths
iv. Find Critical Path
v. Find E and L for each event.
vi. Find EST, EFT,LST,LFT for each activity
vii. Find Float for each activity.
viii. State the purpose of finding critical path and float.

Q1B	A company manufactures around 200 mopeds Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below: The finished mopeds are transported in a specially designed three storied lorry that can accommodate only 200 mopeds. Using the following 15 random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54, and 10. Simulate the process to find out: i. What will be the average number of mopeds waiting? ii. What will be the number of empty spaces in the lorry? Explain the process of Simulation	10	M7	CO2 CO4
Q2A	A company has developed a MPS for two products A and B as shown below. The final assembly line has available weekly capacity of 200 hrs. Each product of A needs 2 hrs and B needs 3 hrs of final assembly capacity. i. Find Final Assembly hour required per week for Product A . ii. Find Final Assembly hour required per week for Product B . iii. Find Total Final Assembly hour required per week on assembly line. iv. Find Total load of 5 weeks in hrs. v. Find total available capacity for 5 weeks in hrs. vi. Find whether the MPS overload or under load the assembly line per Week. vii. Does the sufficient final assembly capacity exist to produce the MPS? viii. Recommend the Changes required.	10	M4	CO1, CO2, CO3
Q2B	Refer the following production situation. 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	10	M6	CO2 CO

Production day	196	197	198	199	200	201	202	203	204
Probability	0.05	0.09	0.12	0.14	0.20	0.15	0.11	0.08	0.06

	MPS for 5 weeks				
Product	Quantity to be produced				
	1	2	3	4	5
A	-	60	60	60	-
B	-	70	-	70	70

Machine	Product			Time Available per Week (Minute)	Cost/week at full capacity (Rs.)
	P1	P2	P3		
A_1	4	6	-	4500	260
A_2	5	9	10	95000	510
A_3	7	8	-	7500	410
B_1	8	-	-	3500	210
B_2	3	8	7	5100	290
Material Cost(Rs.)	0.35	0.45	0.55		
Sale Price(Rs.)	1.60	1.70	2.20		

	one unit of each of product on each type of machine is given below. Formulate the L.P. model to maximize the profit			
Q3A	The oil India is considering whether to go for an offshore oil drilling contract to be awarded in Mumbai High. If they Bid value would be Rs 600 million with 65% chance of gaining the contract. They may set up a new drilling operation or move already existing operation which has proved successful to new site. The Probability of success and expected returns are as follows.	10	M5 M6	CO1 CO3

Outcome	New Drilling Operation		Existing Drilling Operation	
	Probability	Expected Revenue In Rs Millions	Probability	Expected Revenue In Rs Millions
Success	0.75	800	0.85	700
Failure	0.25	200	0.15	350

- If the corporation do not bid or lose the contract they can use Rs 600 million to modernise their operations.
- This would result in return of 5% or 8% on sum invested with probabilities 0.45 and 0.55
- Construct the Decision Tree and Give your recommendation to Oil India Corporation.

Q3B	Five Jobs 1,2,3,4,5 are to be assigned to 5 machines M1, M2, M3, M4, M5. The cost of assigning these jobs to machines in Rupees is given in the following matrix. Find The optimal Assignment and total cost of Assignment.	10	M7	CO2

Jobs	**M1**	**M2**	**M3**	**M4**	**M5**
1	6	7	5	9	4
2	7	5	10	9	6
3	5	4	3	6	5
4	8	3	5	6	4
5	4	7	5	6	6

Q4A	A firm assembles and sells two different types of motors, A and B , using four resources. The production process can be described as follows :	10	M6	CO1, CO2

Resources	**Capacity per month**
Motor unit shop resource	350 Type A units or 250 Type B units Or any linear combination of the two .
Type A gear and drive shop resources	225 Type A units
Type B gear and drive shop resources	175 Type B units
Final assembly resources	250 Type A units or 200 Type B Units Or any linear combination of the two

Type A units bring in a profit of Rs.110 each and type B units, Rs.90 each. What should be the optimum product mix? Solve Graphically. State the applications of LPP.

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

16/6/23

End Semester Examination June 2023

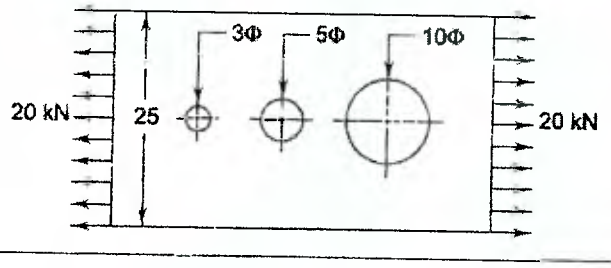
Program: Third Year B.Tech. Mechanical Engineering | **Duration: 03 Hrs**

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

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

T.Y.B Tech (mech) Sem - 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) What is the significance of theories of failure? Discuss the most commonly used theories. b) Draw and explain stress strain curve for ductile materials. c) Designate ferrous casting on the basis of chemical composition. d) Name any five organization provides a clue to the nature of the standard or code.	20	3	2	3.7.1
2	Design a knuckle joint for a tie rod of circular cross section to sustain a maximum tensile load of 70 KN. The ultimate tensile strength of the rod against tension is 420 MPa. The ultimate tensile and shearing stresses for the pin material are 500 MPa and 360 MPa respectively. Take Factor of safety as 6. Draw neat sketch highlighting major dimensions.	20	1	5	5.4.1
3	a) Explain goodman and soderberg line with graphical representation. b) A rectangular plate, 15 mm thick, made of a brittle material is shown in Fig. Calculate the stresses at each of three holes of 3, 5 and 10 mm diameter. 	10 10	1	3	5.4.2

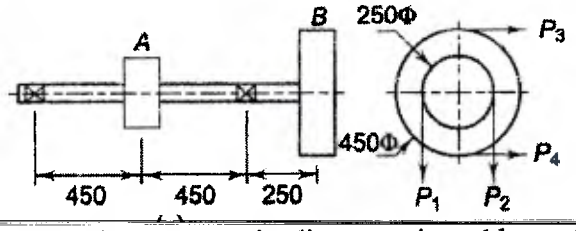
Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination June 2023

4	A line shaft supporting two pulleys A and B is shown in Fig. Power is supplied to the shaft by means of a vertical belt on the pulley A, which is then transmitted to the pulley B carrying a horizontal belt. The ratio of belt tension on tight and loose sides is 3:1. The limiting value of tension in the belts is 2.7 kN. The shaft is made of plain carbon steel 40C8 (Sut = 650 N/mm^2 and Syt = 380 N/mm^2). The pulleys are keyed to the shaft. Determine the diameter of the shaft according to the ASME code if, kb = 1.5 and kt = 1.0  	20	2	4	5.5.1
5	a) A safety valve, 40 mm in diameter, is to blow off at a pressure of 1.2 MPa. It is held on its seat by means of a helical compression spring, with initial compression of 20 mm. The maximum lift of the valve is 12 mm. The spring index is 6. The spring is made of cold drawn steel wire with ultimate tensile strength of 1400 N /mm^2. The permissible shear stress can be taken as 50% of this strength. (G = 81370 N/mm^2). Calculate: a. wire diameter; b. mean coil diameter; and c. number of active coils. b) Explain nipping phenomenon in case of multi leaf spring and derive the expression for the same.	10 10	2	4	5.4.2
6	a) A shaft running at 120 rpm is to drive another shaft at 240 rpm and transmits 10 KW. The belt is 120 mm wide and 10 mm thick. The coefficient of friction between belt and pulley is 0.25. The distance between the shafts is 3 m and the smaller pulley is of 600 mm diameter. Calculate the stress in the belt assuming open belt drive system. b) Explain chain drive with its types mentioning suitable examples.	12 04 04	2	5	5.4.1

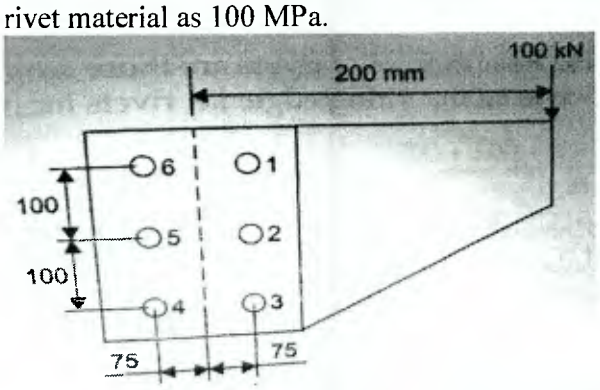
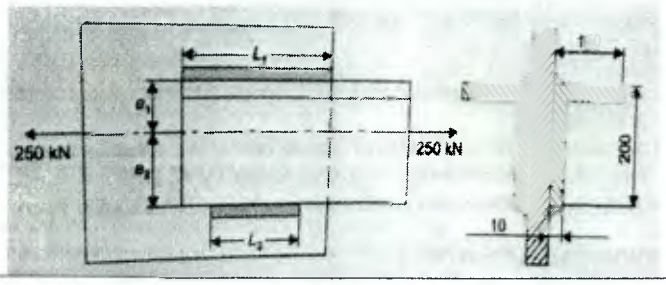
Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination June 2023

7	a) Determine the size of the rivets required for the bracket shown in figure. Take the permissible shear stress for the rivet material as 100 MPa.  b) Two angles 200 X 150 X 10 mm plates are welded to a gusset plate by means of parallel weld along the longer leg of the angle. Determine the length of the welds required if the angles carry a load of 250 KN and the allowable shear stress is limited to 90 MPa. 	10 10	2	4	5.5.1

BharatiyaVidyaBhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination June-2023

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

Course Code: PC-BTM611 | **Maximum Points: 100**

Course Name: Refrigeration and Air-Conditioning. | **Semester: VI**

19/4/23

Instructions: T.Y. B Tech (mech) Sem-VI

1) **Question number ONE is compulsory and solve any FOUR questions out of remaining SIX**
2) **Use of refrigerant properties table and psychrometric chart is permitted.**
3) **Use of steam table is permitted.**
4) **Assume suitable data, mention it and justify the same.**

Q.No.	Questions	Points	CO	BL	Module Number
1(a)	For vapour compression refrigeration cycle draw following diagrams: i) Schematic of components diagram ii) Temperature-entropy diagram iii) Pressure-enthalpy diagram Also define 1 ton of refrigeration (TR) and show how it is equal to 3.51 KW from the definition. Take latent heat of fusion of ice (h_{if} = 334.5 KJ/kg)	03 02	1	1	1
1(b)	Draw neat sketch three fluid refrigeration system and name all parts in the system (no explanation is required).	05	1	1	7
1(c)	Write the designation system of refrigerants for various categories of refrigerants.	05	1	1	2
1(d)	Investigate the effect of humidity on the density of moist air by computing the vapour density for an air water vapour mixture at 26°C and relative humidities of 0, 50 and 100 per cent. Also, for each case compare the values of the degree of saturation to the values of relative humidity.	05	2	3,4	3
2(a)	Draw schematic diagram and T-s diagram of regenerative aircraft refrigeration system and explain its working. Also write an expression for COP of the system.	08	1	1	1
2(b)	(i) A R134a simple-saturation cycle refrigerator operates at 40°C condenser temperature and -16°C evaporator temperatures. Evaluate COP and HP/TR. (ii) If a liquid vapour regenerative heat exchanger is installed in the system, with the suction vapour at 15°C, what will be the	12	1	2	1

	effect on COP and HP/TR?				
3(a)	What is ozone depletion potential (ODP) and global warming potential (GWP)? How refrigerants are link to ODP and GWP. How ozone layer gets depleted by the use of CFC's explain in detail.	10	3	2	2
3(b)	Explain the thermodynamic wet bulb temperature in detail. State in case of air how the wet bulb temperature is equal to the thermodynamic wet bulb temperature.	10	4	2	3
4(a)	Discuss various desirable properties of ideal refrigerants.	10	2	3	2
4(b)	The DBT and WBT of the air are 40°C and 28°C respectively. Find the followings if total air pressure is 1.03 bar. Calculate following without using psychrometric chart. (i) Specific humidity (ii) Relative humidity (iii) DPT (iv) density (iv) Enthalpy.	10	3	1	3
5	Given for a conditioned space: Room sensible heat gain = 20 kW Room latent heat gain = 5 kW Inside design conditions = 25°C DBT, 50% RH Bypass factor of the cooling coil = 0.1 The return air from the space is mixed with the outside air before entering the cooling coil in the ratio of 4:1 by weight. Estimate the followings: (i) Apparatus dew point (ii) Condition of air leaving cooling coil (iii) Dehumidified air quantity. (iv) Ventilation air mass and volume flow rates (v) Total refrigeration load on the air conditioning plant.	20	4	3,4	4
6(a)	Explain various methods of duct design for air distribution in centralize air conditioning plant.	10	3	2	5
6(b)	Discuss mechanism of body heat loss and explain mathematical model of heat exchange between man and environment.	10	3	2	6
7(a)	Draw a comfort chart and explain it in detail.	10	3	2	6
7(b)	Draw schematic diagram of simple vapour absorption system and explain it in detail. Also derive an expression for maximum COP of heat operated refrigeration machine (simple VARS system)	10	1	2	7

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination – ~~MAY~~ JUNE 2023 Examinations

21/6/23

Program: BTECH (MECHANICAL ENGG.)

Course Code: PC-BTM606

Course Name: CAD/CAM/CIM

Duration: 3hrs

Maximum Points: 100

Semester: VI

T.Y. BTech (mech) – Sem VI

Important Notes:

- Solve any five questions out of seven
- Figures to the right indicates full marks
- Assume suitable data wherever necessary

Q.No.	Questions	Points	CO	BL	PI
Q.1 (a)	A triangle having vertices A(2,3) B(6,3) & C(4,8) is reflected about a line Y = 3x + 4. Find the final position of the triangle.	[10]	1	1	3.2.1
(b)	Write a C++ program for Bezier Curve.	[06]	2,4	3	5.2.1
(c)	Explain Cohen Sutherland Algorithm with figure.	[04]	3	3	5.2.1
Q.2 (a)	A triangle is defined by 3 vertices A (0,2,1) B (2,3,0), C (1,2,1). Find the final coordinates after it is rotated by 45 degree around a line joining the points (1,1,1) and (0,0,0)	[10]	2	3	3.2.1
(b)	Construct a Bspline curve for open uniform vectors with n=3 and K=4 with polygon vertices A(1,1), B(2,3), C(4,3), and D(6,2).	[10]	1	1	3.2.1
Q.3 (a)	What is Adaptive Control (AC)? Explain the sources of variability for AC in machining conditions along with neat sketches? Also explain Adaptive Control Optimization (ACO) & Adaptive Control Constraint (ACC) with neat block diagrams?	[10]	3	3	5.2.1
(b)	Explain CAPP & CAQC with neat sketches?	[10]	2,3,4	1	3.2.1

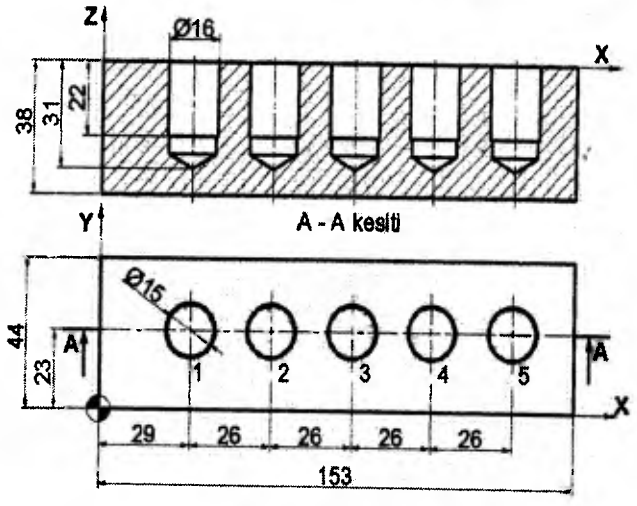
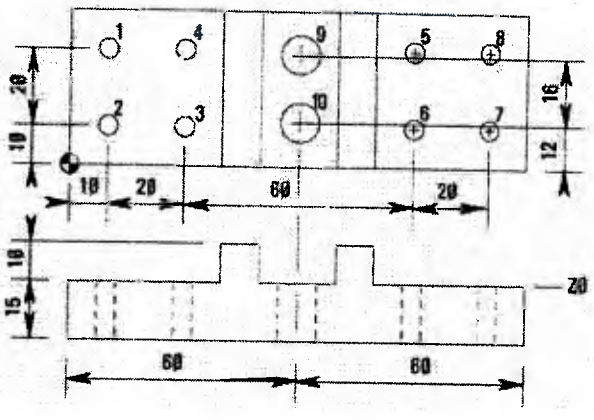
Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination – ~~MAY~~ JUNE 2023 Examinations

Q.4 (a)	 **Fig.a** Formulate a CNC program for the given fig.a using G85 Canned Cycle	[05]	4	3	5.2.1
(b)	• Explain significance of G98 & G99 codes along with neat sketches? • Explain Tool Length Compensation with neat sketch	[05]	1	2	5.2.1
(c)	 **Fig.C** Formulate a CNC program for the given fig.c using G81 Canned Cycle (For holes 1 to 8) & G83 Canned Cycle (For holes 9 to 10). Also use G98 and G99 code along with G81 & G83 canned cycles.	[10]	3	3	5.2.1

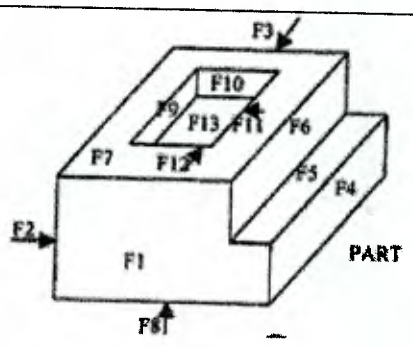
Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester Examination – ~~MAY~~ JUNE 2023 Examinations

Q.5 (a)	 **Fig.b** For the object shown above in Fig.b use the graph based feature recognition approach to achieve the following • Develop the AAG of the given object • Give the matrix representation of the AAG • Recognize the features in this object	[10]	3	3	5.2.1
(b)	Explain Bresenhams Circle Algorithms	[06]	3	3	5.2.1
(c)	Explain the properties of Bezier curve with neat sketches	[04]	3	3	5.2.1
Q.6	Write a C++ program for following 2D transformations using class & object • Translation • Scaling • Rotation • Reflection • Shearing Insert comments wherever necessary.	[20]	2,4	3	5.2.1
Q.7	Write Short Notes on (Any Three) • Graphics Standards • Computer Integrated Manufacturing (CIM) • Augmented Reality • Design for Assembly (DFA) • Structured Query Language (SQL)	[20]	3,4	2	5.2.1, 3.2.1

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058

END SEMESTER EXAMINATION, June-2023

Program: **B. Tech. in Mechanical Engineering**

Class: **Third Year B. Tech. (Mechanical)**

Course code: **PCC-BTM 614**

Course: **Internal Combustion Engines**

T.Y. BTech (Mech) - Sem-VI

Date: **23 June 2023**

Duration: **3 Hr.**

Max. Points: **100**

Semester: **VI**

23/6/23.

Instructions:

- **Solve ANY O5 of the following questions.**
- Draw **neat system diagram /Sketches / process diagrams** wherever necessary.
- **Assume suitable data** wherever necessary and **state the same.**
- Answers to the questions should be **Brief and Specific in Legible hand writting,**

Q. N.	Question	Points	CO	Module	BL	PI
1.	A) **Discuss:** Classification of I.C. Engines. **Explain:** Working of a four-stroke petrol engine. **Draw:** 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)	1	2	I,II	1.4.1
	B) **Explain:** Significance of fuel-air cycle and how it differs from an air-standard cycle. **Draw:** Neat sketches. In an air standard Otto cycle, air at 17 °C and 1 bar is compressed adiabatically until the pressure is 15 bar. Heat is added at constant volume until the pressure rises to 40 bar. **Calculate**: Mean effective pressure of the cycle. Assume Cv = 0.717 kJ/kg K and gas constant R = 0.287 kJ/kg. K for air as the working fluid.	(10)	1,2	1, 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 of the solid fuel injection system. **Draw:** Neat sketch.	(10)	1,4	3	I,II	1.4.1
	B) **Explain:** i) Mechanical Efficiency ii) Relative Efficiency of an I.C. Engine. A Four-stroke S.I. engine develops a brake power of 20.9 kW. The bore of the engine is 75 mm and the stroke is 90 mm. A Morse Test was conducted on this engine and the brake power (kW) obtained when each cylinder was separately made inoperative by short circuiting the spark plug are 14.9, 14.3, 14.8 and 14.5 kW respectively. The test was conducted at constant speed of 3000 rpm.	(10)	2,3	4	II, V	1.4.1

	Determine: i) Indicated power ii) Mechanical efficiency iii) bmep when all the cylinders are firing and engine is operational with all the four cylinders.					
4.	A) **Explain:** i) Delay period ii) Diesel knock. **Compare:** Knocking in S.I. and C.I. engines.	(10)	1	2,3	I,II	1.4.1
	B) During the trial of a single cylinder four-stroke diesel engine, With Cylinder diameter = 20 cm and Stroke = 40 cm, following results were obtained: Mean effective pressure = 6 bar, Torque = 407 N.m, Speed = 250 rpm, Oil consumption = 4 kg/h, Calorific value of fuel = 43 MJ/kg, Cooling water flow rate = 4.5 kg/min, Air used per kg of fuel = 30 kg, Rise in cooling water temperature = 45 °C, Temperature of exhaust gases = 420 °C, Room temperature = 20 °C, Mean specific heat of exhaust gas = 1 kJ/kg K, Specific heat of water = 4.18 kJ/kg K **Evaluate:** i) Indicated power ii) Brake power. **Prepare:** Heat balance sheet for the test in kJ/h.	(10)	2,3	4	V, VI	1.4.1
5.	A) **Justify:** Four stroke engines are more fuel economic and environment friendly as compared to Two stroke engines. **Draw:** Neat sketches.	(07)	4	1,5	I, V	1.4.1
	(B) **Explain:** Significant properties of fuels for use in S.I. Engine.	(07)	4	5	II	1.4.1
	(C) **Explain:** i) Octane Number ii) Cetane Number	(06)	4	5	II	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 any one of the water cooling system. **Draw:** Neat diagram.	(10)	4	6	I, II, V	~~1.4.1~~
	B) **List:** Various alternative liquid fuels for I.C. Engines. **Discuss:** Suitability of biodiesel as an effective alternative C.I. engine fuel for diesel engines in terms of its properties and environmental effects.	(10)	4	7	I, II	1.4.1
7.	A) **Justify:** Necessity of lubrication and **State:** Various lubrication systems for I.C. Engines. **Describe:** Any one of the Wet sump lubrication system. **Draw:** Neat sketch.	(10)	4	6	I, II, V	1.4.1
	B) **State:** Various alternative gaseous fuels for I.C. Engines. **Compare:** Advantages and disadvantages of using Hydrogen, CNG and LPG as S.I. Engine fuel.	(10)	4	7	I, V	1.4.1

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

26/6/23.

End-Sem Examinations June 2023

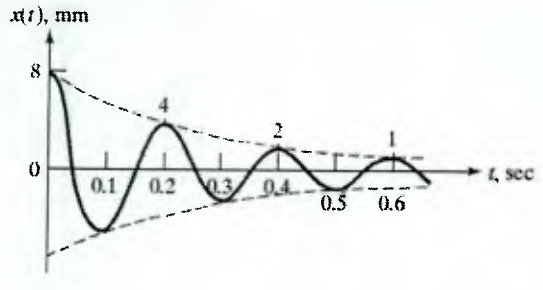
Program: T. Y. B Tech (Mechanical Engg.) **Duration:** 3 hr

Course Code: PE-BTM518 **Maximum Points:** 100

Course Name: Mechanical Vibration **Semester:** VI

T.Y.B.Tech (mech) Sem - VI

1. Q. no. 1 is compulsory, solve any four out of remaining.
2. Answers to each sub-questions must be grouped together
3. Use of scientific calculator is allowed
4. Begin answer to each question on new page.
5. Candidates should write the answers legibly

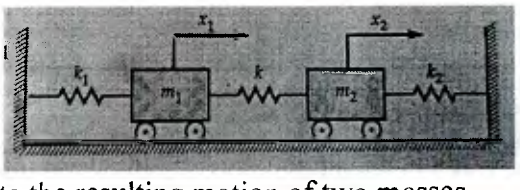
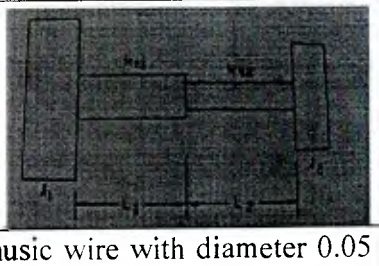
Q.No.	Questions	Pts	Co	BL
1	Answer the following: a) In practice, the measurement of vibration has become necessary, Why? (discuss any five point). b) Discuss in detail se-definite system of a two DoF vibrating system. c) Discuss the Beats phenomenon when a SDoF is subjected to external forcing frequency. d) How does a continuous system differ from a discrete system in vibration analysis? Discuss.	5x4	1,3, 4	3,4
2	a) A damper offers resistance 1.2 N at constant velocity 4 cm/sec. The vibrating system consists of a spring $K = 100$ N/m along with this damper. Calculate the following for this single-degree-of-freedom system having mass $m = 4$ kg, *i.* Natural time period, τ *ii.* Damped frequency, ω_d *iii.* Critical damping constant, *cc* *iv.* Damping ratio, ξ *v.* Logarithmic decrement, δ b) The free-vibration responses of an electric motor of weight 450 N mounted on the foundation is shown in Fig. Identify the following: (i) the undamped and damped natural frequencies of the electric motor, and (ii) the spring constant and damping constant of the foundation. 	5 15	1,2, 3	2,3

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

End-Sem Examinations June 2023

3	a) A machine of mass one ton is acted upon by an external force of 2500 N at a frequency of 1440 rpm. To reduce the effect of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping ζ =0.15 are used. Determine : a) the force transmitted to the foundation b) the amplitude of vibration of machine c) phase lag. b) A vehicle of mass 600 kg and total spring constant of its suspension system is 60 kN /m . The profile of the road may be approximated to a line curve of amplitude 4.0 cm and wavelength of 4.0 meters. Determine: a) the critical speed of the vehicle b) amplitude of the steady state motion of the mass when the vehicle is driven at critical speed and at speed of 57 kmph, take the damping factor is 0.45 .	10 10	1,2	2,3
4	a) For the system shown in figure M_1= 1 kg, M_2= 2kg, K_1 =2kN/m , K_2 = 1kN/m, K_3 =3kN/m and an initial velocity of 20 m/s is imparted to mass M_1; Calculate the resulting motion of two masses.  b) Show that mode shapes in above example are orthogonal.	15 5	2,3	3,4
5	a) A spring-mass system with m = 0.5 kg and k = 10,000 N/m, with negligible damping, is used as a vibration pickup. When mounted on a structure vibrating with amplitude of 4 mm, the total displacement of the mass of the pickup is observed to be 12 mm. Find the frequency of the vibrating structure. b) Draw flow-diagram of basic vibration measurement scheme. Discuss the function of each block. c) Write short note on Accelerometer.	8 6 6	1,2 3	3,4
6	Derive the expression for the natural frequency of the torsional system shown in fig. and draw the normal mode curve. Show that the nodal distance from J_2 is $L_2\left(1+\frac{k_{t2}}{k_{t1}}\right)/(1+\frac{J_1}{J_2})$. 	20	1,2 3	2,3
7	a) The strings of guitar are made of music wire with diameter 0.05 mm, weight density 76.5 kN/m^3, E= 207 GPa. If the length of two of the strings is 60 cm and 65 cm each, determine the fundamental natural frequencies of the strings. The tension in each string is 50 kN. b) Describe the Holzer method.	8 12	2,3	3,4

Mechanical Vibration_PE-BTM518(formulae) _June2023

Free Undamped SDOF:

- Equation of motion

$$x(t) = A_1 \cos \omega_n t + A_2 \sin \omega_n t$$

$$x(t) = x_0 \cos \omega_n t + \frac{\dot{x}_0}{\omega_n} \sin \omega_n t$$

- Amplitude:

$$A = \sqrt{(A_1^2 + A_2^2)} = \sqrt{x_0^2 + \left(\frac{\dot{x}_0}{\omega_n}\right)^2}$$

- Phase Angle

$$\phi = \tan^{-1}\left(\frac{\dot{x}_0}{x_0 \omega_n}\right)$$

Response of Free SDOF Underdamped Vibration

$$C_1' = x_0, \quad C_2' = \frac{\dot{x}_0 + \zeta \omega_n x_0}{\sqrt{1 - \zeta^2}\omega_n}$$

$$X = X_0 = \sqrt{(C_1')^2 + (C_2')^2} = \frac{\sqrt{x_0^2 \omega_n^2 + \dot{x}_0^2 + 2x_0 \dot{x}_0 \zeta \omega_n}}{\sqrt{1 - \zeta^2}\omega_n}$$

$$\phi_0 = \tan^{-1}\left(\frac{C_1'}{C_2'}\right) = \tan^{-1}\left(\frac{x_0 \omega_n \sqrt{1 - \zeta^2}}{\dot{x}_0 + \zeta \omega_n x_0}\right)$$

2DOF:

- **Equation of motion:**

$$[m]\ddot{\vec{x}}(t) + [c]\dot{\vec{x}}(t) + [k]\vec{x}(t) = \vec{f}(t)$$

- **Frequency or Characteristic Equation:**

$$\det\begin{bmatrix} \{-m_1\omega^2 + (k_1 + k_2)\} & -k_2 \\ -k_2 & \{-m_2\omega^2 + (k_2 + k_3)\} \end{bmatrix} = 0$$

- **MODE SHAPE:**

$$r_1 = \frac{X_2^{(1)}}{X_1^{(1)}} = \frac{-m_1\omega_1^2 + (k_1 + k_2)}{k_2} = \frac{k_2}{-m_2\omega_1^2 + (k_2 + k_3)}$$

$$r_2 = \frac{X_2^{(2)}}{X_1^{(2)}} = \frac{-m_1\omega_2^2 + (k_1 + k_2)}{k_2} = \frac{k_2}{-m_2\omega_2^2 + (k_2 + k_3)}$$

$$\vec{x}^{(1)}(t) = \begin{Bmatrix} X_1^{(1)}(t) \\ X_2^{(1)}(t) \end{Bmatrix} = \begin{Bmatrix} X_1^{(1)} \cos(\omega_1 t + \phi_1) \\ r_1 X_1^{(1)} \cos(\omega_1 t + \phi_1) \end{Bmatrix} = \text{first mode}$$

$$\vec{x}^{(2)}(t) = \begin{Bmatrix} X_1^{(2)}(t) \\ X_2^{(2)}(t) \end{Bmatrix} = \begin{Bmatrix} X_1^{(2)} \cos(\omega_2 t + \phi_2) \\ r_2 X_1^{(2)} \cos(\omega_2 t + \phi_2) \end{Bmatrix} = \text{second mode}$$

Sr. No.	Name	Z	Φ
1	Vibration Pickups/ Accelerometer	$\frac{r^2\gamma}{[(1 - r^2)^2 + (2\zeta r)^2]^{1/2}}$	$\tan^{-1}\left(\frac{2\zeta r}{1 - r^2}\right)$

Continuous vibration n[th] mode of vibration	$w_n(x,t) = W_n(x)T_n(t) = \sin\frac{n\pi x}{l}\left[C_n \cos\frac{nc\pi t}{l} + D_n \sin\frac{nc\pi t}{l}\right]$
$C_n = \frac{2}{l}\int_0^l u_0(x) \sin\frac{(2n+1)\pi x}{2l}\,dx$	$D_n = \frac{4}{(2n+1)\pi c}\int_0^l \dot{u}_0(x) \sin\frac{(2n+1)\pi x}{2l}\,dx$

Mechanical Vibration_PE-BTM518(formulae) _June2023

A. Forced Vibrations

Sr. No.	System Type	Xp/δst	Φ	r for Mmax	Force Transmitted to Base	Mmax
1	Forced Undamped System	$1/(1-r^2)$	-	1	-	∞
2	Forced Damped System	$\frac{1}{\sqrt{(1-r^2)^2+(2\zeta r)^2}}$	$\tan^{-1}\left(\frac{2\zeta r}{1-r^2}\right)$	$\sqrt{1-2\zeta^2}$	-	$\frac{1}{2\zeta\sqrt{1-\zeta^2}}$
3	Damped System under Harmonic Base Motion	$\left[\frac{1+(2\zeta r)^2}{(1-r^2)^2+(2\zeta r)^2}\right]^{1/2}$	$\tan^{-1}\left[\frac{2\zeta r^3}{1+(4\zeta^2-1)r^2}\right]$	$r_m=\frac{1}{2\zeta}\left[\sqrt{1+8\zeta^2}-1\right]^{1/2}$	$\frac{F_T}{kY}=r^2\left[\frac{1+(2\zeta r)^2}{(1-r^2)^2+(2\zeta r)^2}\right]^{1/2}$	-
4	Damped System under Rotating Unbalance	$\frac{MX}{me}=\frac{r^2}{\left[(1-r^2)^2+(2\zeta r)^2\right]^{1/2}}$	$\tan^{-1}\left(\frac{2\zeta r}{1-r^2}\right)$	$\frac{1}{\sqrt{1-2\zeta^2}}$	$\lvert F\rvert=me\omega^2\left[\frac{1+(2\zeta r)^2}{(1-r^2)^2+(2\zeta r)^2}\right]^{1/2}$	$\frac{1}{2\zeta\sqrt{1-\zeta^2}}$

1.	2 DOF system under external forces	$[Z(i\omega)]\vec{X}=\vec{F}_0$
2.	Mechanical Impedance	$Z_{rs}(i\omega)=-\omega^2 m_{rs}+i\omega c_{rs}+k_{rs}, \quad r,s=1,2$
3.	Impedance Matrix	$[Z(i\omega)]=\begin{bmatrix} Z_{11}(i\omega) & Z_{12}(i\omega) \\ Z_{12}(i\omega) & Z_{22}(i\omega) \end{bmatrix}$
4.	Solution	$X_1(i\omega)=\frac{Z_{22}(i\omega)F_{10}-Z_{12}(i\omega)F_{20}}{Z_{11}(i\omega)Z_{22}(i\omega)-Z_{12}^2(i\omega)}$ $X_2(i\omega)=\frac{-Z_{12}(i\omega)F_{10}+Z_{11}(i\omega)F_{20}}{Z_{11}(i\omega)Z_{22}(i\omega)-Z_{12}^2(i\omega)}$
5.	Dynamic Vibration Absorber: (two resonant frequencies at which amplitude equals infinity)	$\left.\begin{matrix}\left(\frac{\Omega_1}{\omega_2}\right)^2 \\ \left(\frac{\Omega_2}{\omega_2}\right)^2\end{matrix}\right\} = \frac{\left\{\left[1+\left(1+\frac{m_2}{m_1}\right)\left(\frac{\omega_2}{\omega_1}\right)^2\right] \mp\left\{\left[1+\left(1+\frac{m_2}{m_1}\right)\left(\frac{\omega_2}{\omega_1}\right)^2\right]^2-4\left(\frac{\omega_2}{\omega_1}\right)^2\right\}^{1/2}\right\}}{2\left(\frac{\omega_2}{\omega_1}\right)^2}$

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

21/6/23.

End Sem Examination June 2023

Program: Mechanical Engineering — **Duration: 3 Hrs**

Course Code: PE BTM 532 — **Maximum Points: 100**

Course Name: Composite Material Technology — **Semester: VI**

Notes: T.Y.B.Tech(mech) - Sem- VI

1. **Q.1** is compulsory
2. Solve any Four out of **Q.2** to Q.7
3. Assume suitable data

Q.No.	Questions	Points	CO	BL	Module No.
1 a	Why composite material is preferred over conventional material. Classification of composite material.	05	I	3	I
1b	Enlist the applications of composite material	05	I	4	VII
1c	Explain the concept of strain and strain compatibility	05	IV	5	III
1 d	Discuss the term isotropy and anisotropy in detail	05	IV	3	IV
1 e	Draw the schematic of glass fiber manufacturing process	05	III	4	V
2a	Classify Metal Matrix Composites with various applications of metal matrix composites. Explain the different metal matrix composites with its advantages and disadvantages.	10	IV	5	V
2 b	Explain various manufacturing processes with neat suitable diagram	10	III	3	V
3 a	Explain the failure criteria for multiaxial loading	10	IV	4	IV
3 b	Design a simple structural composite element	10	IV	5	VII
4a	Reduce C_{ijkl} elements of composites to 2 constants using isotropy	10	IV	3	IV
4b	Reduce C_{ijkl} of composites to 21 using anisotropy	10	IV	4	IV

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

End Sem Examination June 2023

5a	Develop an equilibrium equation	10	IV	3	VII
5b	Explain the traction of oblique plane	10	IV	4	VII
6a	Develop strain tensor of composite	10	IV	5	IV
6b	Develop stress tensor of composite	10	III	5	IV
7a	Explain the ceramic matrix composites how CMC manufactured with neat diagram and its applications	10	II	5	VI
7b	Explain the post processing operation of composites such as cutting, machining and polishing etc.	10	III	5	VI

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

END SEMESTER EXAMINATION JUNE 2023

16/6/23

Program: Mechanical Engineering

Course Code: **PE BTM537**

Course Name: **Tool Engineering**

Duration: 3 Hours

Maximum Points: 100

Semester: 6

INSTRUCTIONS: T.Y.BTech (Mech) - Sem-(6) VI

1. Question no 1 is compulsory and Attempt any four questions out of remaining six questions.
2. Draw neat schematic diagrams wherever is necessary, highlight important points of answer.
3. Assume suitable data if necessary and mention it.

Q.No.	Questions	Point	CO	Module
1A	Obtain expression for shear strain using the neat labeled sketch during metal cutting operation? Write a short note on a high speed steel (HSS) tool with reference to its types, composition, tool failure mode?	10	1	1
1B	Explain working principle of *strain gauge type 3D Milling dynamometer* with the help of a well labeled neat sketch? Suggest the most sophisticated way of measuring cutting forces and give its working principle?	10	2	3
2A	During orthogonal machining operation on mild steel, results obtained are t_1 (uncut chip thickness)=0.5 mm, t_2 (chip thickness)=0.9 mm, w= 2 mm, rake angle = 10^o, Cutting force F_C = 950 N, Thrust force F_T = 475 N Determine a) coefficient of friction between tool and chip, b) shear plane angle, c) magnitude of shear force?	10	1	1
2B	What are different functions of cutting fluid used for machining? Enlist important effects of these functions on tool, chip removal and work-piece quality?	10	2	3
3A	Draw single point cutting tool geometry features with the help of well labeled schematic sketch in orthogonal reference system and normal rake system?	10	2	2
3B	Draw a detailed schematic sketch of a punched hole and slug showing their characteristic feature? Explain how punch speed affects the burr formation in case of shearing operation?	10	4	5

<table>
<tr><td>4A</td><td>Give effect of following, on quality of machined work-piece surface using sketch: Effect of 1) Tool nose radius (with expression), 2) Rake angle?</td><td>10</td><td>2</td><td>2</td></tr>
<tr><td>4B</td><td>A steel washer with outer diameter as 55 mm and inner diameter as 30 mm, which is 10 mm thick. If washer work material is having maximum shear stress of 500 N/mm^2. Minimum percentage penetration required for shearing operation is 30% of thickness. Calculate: a) Work-done, b) Shear to be ground on tool if punch force to be reduced to 0.075MN.</td><td>10</td><td>3</td><td>5</td></tr>
<tr><td>5A</td><td>Write a short note on following terms i) Rate sensitivity , ii) Planar anisotropy in a sheet-metal specimen?</td><td>10</td><td>4</td><td>7</td></tr>
<tr><td>5B</td><td>Explain what are different forgeability tests?
Draw sketch of rotary forging machine and write short note on this process?</td><td>10</td><td>3</td><td>6</td></tr>
<tr><td>6A</td><td>A Cup has height (h) of 80 mm and diameter (d) 70 mm, corner radius is 3 mm, thickness is 1 mm, work piece material is medium carbon steel (having yield strength of 3600 kg/cm^2). Assume radius of punch is equal to 3 times thickness, radius of die is twice the thickness, clearance is 1.09 times thickness of stock, value of constant 'k' for drawing pressure of material is 0.65, force of friction and blank holder force required is one third of drawing force.

Calculate- i) Blank diameter (with trimming allowance), ii) Number of draw passes required, punch diameter (d_{ip}) and die opening (d_{id}) for different pass and percentage reduction during each pass, iii) Drawing force ,blank holder and frictional force, Press capacity required? (Refer table 1)
Table 1.
<table>
<tr><td>Draw ratio e= (h/d)</td><td>No. of reduction passes</td><td colspan="3">% reduction</td></tr>
<tr><td></td><td></td><td>1st Draw</td><td>2nd Draw</td><td>3rd draw</td></tr>
<tr><td>0.75</td><td>1</td><td>40</td><td></td><td></td></tr>
<tr><td>0.75-1.5</td><td>2</td><td>40</td><td>25</td><td></td></tr>
<tr><td>1.5-3</td><td>3</td><td>40</td><td>25</td><td>15</td></tr>
</table></td><td>10</td><td>4</td><td>7</td></tr>
<tr><td>6B</td><td>Draw neat sketch of Four-high mills and Cluster Mills. Give their advantages over two high roll mill?
Explain any two characteristics of Rolled material?</td><td>10</td><td>3</td><td>4</td></tr>
</table>

7A	Draw a well labeled sketch of Impression-die forging set-up for manufacturing "I" section. Give all Die Design Features for this?	10	3	6
7B	Discuss Defects in Rolled Plates and Sheets along with sketch? Write a short note on cold thread rolling operation?	10	3	4

Bharatiya Vidya Bhavan's

Sardar Patel College of Engineering

(A Government Aided Autonomous Institute)

Munshi Nagar, Andheri (West), Mumbai – 400058

END SEM EXAMINATION, June-2023

Program: **B. Tech. in Mechanical Engineering**
Class: **Third Year B. Tech. (Mechanical)**
Course code: **PEC-BTM 538**
Course: **Industrial Management and Enterpreneurship**
T.Y.B.Tech(mech) Sem-VI

Date: **26 June 2023**
Duration: **3 Hr.**
Max. Points: **100**
Semester: **VI**

Instructions:

- Attempt **ANY 05** questions out of the following
- Draw **neat diagram /Sketch/Block Diagram** wherever necessary.
- Use **Graph paper** for drwaing Break-Even Chart
- Answers to the questions should be **Brief and Specific in legible handwriting.**

Q. N.	Question	Points	CO	Module	BL	PI
1	**A) Differentiate:** Between management and administration. **List:** Various functions of management. **Explain:** Any four of them.	10	1	1	I, II	9.1.1
	B) Explain: Functions of a manager and skills required by a manager to serve these functions.	10	1	1	II	9.1.1
2.	**A) List:** Various theories of motivation. **Explain:** i) Theory X and Theory Y ii) Maslow's Hierarchy of needs theory of motivation. **Illustrate:** With example in an industrial scenario.	10	1	2	I, II, III	9.1.1
	B) State: Various functions of Human Resource (HR) Management. **Explain:** HR functions of i) Recruitment and selection ii) Training and development.	10	1	2	I,II	9.1.1
3	**A) Explain:** i) Elements of cost and ii) Nature of cost. In a casting foundry, two moulders cast 20 pulleys per day. Each pulley weighs 2 kg and the cost of raw material of gear is Rs. 20 per kg. Each moulder is paid Rs. 200/- per day. The overhead expenses are 150% of direct labour cost. **Calculate:** Cost of production of each pulley.	10	2	3	II,V	9.1.1
	B) Differentiate: 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: Use and limitations of break-even analysis as a managerial tool. For a certain financial year, ABC Company expects a sale revenue of Rs. 2,00,000 by selling all the produced units at Rs. 20 per unit. The fixed cost is Rs. 80,000 and the variable cost is Rs. 4 per unit. **Construct:** Break-even chart and **Determine:** i) Sales volume and ii) Sales revenue for break-even point.	10	2	3, 4	II, III, V	9.1.1
5	**A) Define:** Enterpreneurship. **Justify:** *An enterpreneur differs from a manager* by describing various entrepreneurial characteristics.	10	3	5	I,V	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) Define:** ERP. **Explain:** Importance of ERP in an industrial organisation.	10	4	7	I, II	9.1.1
	B) Explain: Steps for implememtation of ERP in an industry.	10	4	7	II	9.1.1
7	**Expalin: ANY THREE** of the following in brief:	20			II	9.1.1
	A) Scientific management		1	1		
	B) Leadership styles		1	2		
	C) Methods of Depreciation		2	3		
	D) Financial Statements		2	4		
	E) ERP-II		4	7		

Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester **s - June 2023 Examinations**

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

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

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

T.Y.B.Tech(mech) Sem- VI

Notes:

1. **Question number 1 and 2 are compulsory**
2. **Solve any three questions from question number 3 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	A startup proposed to develop the machine with additive approach to prepare toast sandwich. The raw material viz tomato, beetroot, and cucumber from the farm along with the slice breads from the bakery will be inputs to the machine. Students shall develop the conceptual design plan depicting the slicing, feeding and locating mechanisms for the input materials for the development of the proposed machine. Design shall be modular, scalable and versatile to have scope for customization and finally the customer delight. Design shall be in the form of labeled drawings and sketches.	20	1 to 4	6	1 to 7
2	Prototype consists of pentagonal pyramid is to be develop using following RP processes (i) Scanning Type Stereolithography (ii) Bulk lithography (iii) Laminated Object Manufacturing (iv) Selective Inhibition Sintering Pentagonal pyramid is to be developed using compatible material for above mentioned processes. State (i) Compatible materials with 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 five 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
3 (A)	Explain .stl and amf file format and its importance.	10	1	3	2
3 (B)	State process of unconstraint depth photopolymerization with the first principles (using nonlinear Shrodinger equation, diffusion and non-linearity due to change of refractive index)	10	3	3	3,4

4 (A)	Explain shape deposition modeling process. Take suitable part geometry to explain processes involved in shape deposition manufacturing.	10	2	5	5
4 (B)	With neat sketches explain projection microstereolithography (MSL)? Discuss advantages and issues with projection surface MSL.	10	1	1	3,4
5 (A)	With neat sketch explain design of flexural mechanism for XY scanning system	10	3	2	3
5 (B)	With neat sketches explain the constraint surface type of microstereolithography.	10	1	3	4
6 (A)	Explain with neat labeled diagram the process plan for development of scaffold type structure for biomedical applications. Explain important aspects in processing slurry way scaffold fabrication. Explain promising materials for applications.	10	4	4	1 to 7
6 (B)	With neat diagram explain Multi-jet modeling process.	10	2	4	5
7(A)	Describe extrusion based RP systems. Discuss Fused deposition modeling (FDM) process with a neat labeled diagram. 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.	10	3	6	5
7(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	6