Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

REEXAM PAPER – JUNE 2022 Examinations

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

Program: BTECH (MECHANICAL ENGG.)

Duration: 3hrs

Course Code: PC-BTM606

Maximum Points: 100

Course Name: CAD/CAM/CIM

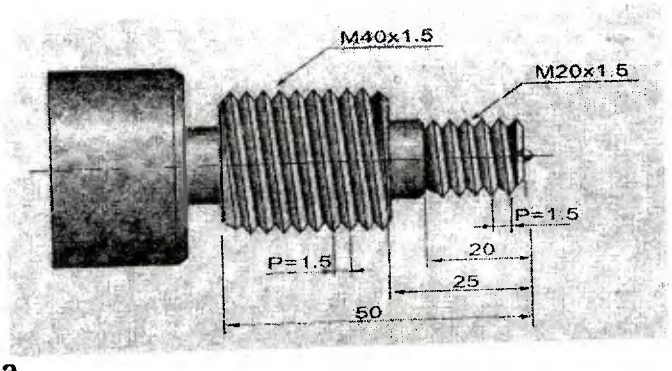
Semester: VI

8/7/22

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)	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 and show the results graphically	[10]	1	1	3.2.1
(b)	Write a C++ program for Bresenhams Line algorithm.	[06]	2,4	3	5.2.1
(c)	Write a short note on Computer Integrated Manufacturing (CIM)	[04]			
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)	The co-ordinates of four control points relative to a current WCS are given by Po=[2 2 0]T, P1=[2 3 0]T, P2=[3 3 0]T, P3=[3 2 0]T Find The equation of the resulting Bezier Curve. Also find the points on the curve for u=0,1/4,1/2,3/4 and 1.	[06]	1	1	3.2.1
(b)	Explain Bresenhams Circle algorithm with steps	[04]	3	3	5.2.1

Q.3 (a)	Explain Graphics standards with neat sketches?	[10]	3	3	5.2.1
(b)	Explain the process of Reverse Engineering with neat sketches	[10]	2,3,4	1	3.2.1
Q.4 (a)	 **Fig.a** Formulate a CNC program for Thread Cutting (M40 & M20) for the given fig.a using G76 Cycle	[06]	4	3	5.2.1
(b)	Write & explain the Syntax of Peck drilling & Grooving cycle? Explain both the cycles with an example by using CNC code.	[06]	1	2	5.2.1
(c)	Explain Computer Aided Process planning with neat sketches?	[08]	3	3	5.2.1
Q.5 (a)	Explain Concurrent Engineering in detail with neat figures	[10]	3	3	5.2.1
(b)	Consider a line from (5,5) to (13,9). Use the Bresenhams Line Algorithm to rasterize the Line	[06]	3	3	5.2.1
(c)	Explain four properties of BEZIER curve with neat sketches	[04]	3	3	5.2.1
Q.6	Write a C++ program using Class & Objects for following 2D transformations. • Translation • Scaling • Rotation • Reflection • Shearing	[20]	2,4	3	5.2.1

	Insert comments wherever necessary.				
Q.7	Write Short Notes on (Any Three) • Object Oriented Databases (OODB) • Relational Data base for design • Augmented Reality • Artificial Intelligence in Design • Structured Query Language (SQL) • DDA Algorithm	[20]	3,4	2	5.2.1, 3.2.1

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Munshi Nagar, Andheri (W) Mumbai – 400058

21/5/22

End Semester Examination – MAY 2022 Examinations

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

Duration: 3hrs
Maximum Points: 100
Semester: 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 Rectangle ABCD is represented by the vertices A(20,20) B(106.603), C(81.603, 113.301), D(-5, 63.01). The Rectangle is rotated 30 degree about the vertex A. Determine the new Vertex positions A', B', C', D'. The transformed rectangle is then to be mirrored about a line joining the diagonal vertices A' and C'. Determine the new vertices of the rectangle.	[10]	1	1	3.2.1
(b)	Write a C++ program for Bezier Curve.	[06]	2,4	3	5.2.1
(c)	Write a short note on Computer Integrated Manufacturing (CIM)	[04]			
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 (2,2,2) and (1,1,1)	[10]	2	3	3.2.1
(b)	A Cubic Spline is represented by the following equation $\mathbf{P(u)= C_3\, u^3 + C_2\, u^2 + C_1\, u + C_0}$ Where 0 <= U <= 1 Where C3, C2, C1, C0 are the Polynomial Coefficients. Determine the four control points of an identical Bezier Curve in terms of these Polynomial Coefficients	[06]	1	1	3.2.1
(b)	Explain Z-Buffer algorithm with neat figures?	[04]	3	3	5.2.1

(c)	Explain four properties of B-Spline curve with neat sketches	[04]	3	3	5.2.1
Q.6	Write a C++ program for following 2D transformations to be performed on line • Translation • Scaling • Rotation • Reflection • Shearing Insert comments wherever necessary. The program should contain code to	[20]	2,4	3	5.2.1
Q.7	Write Short Notes on (Any Three) • Object Oriented Databases (OODB) • Relational Data base for design • Augmented Reality • Artificial Intelligence in Design • Structured Query Language (SQL) • Gouraud Shading Algorithm	[20]	3,4	2	5.2.1, 3.2.1

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SARDAR PATEL COLLEGE OF ENGINEERING

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Munshi Nagar, Andheri (W) Mumbai – 400058

Re-Examination July 2022

Program: B.Tech. Mechanical Engineering **Duration: 03 Hrs**

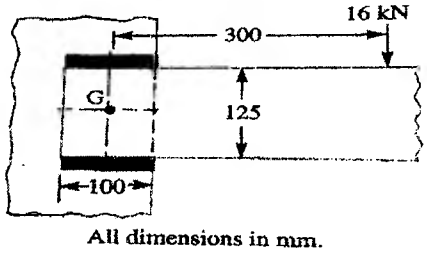
Course Code: PC–BTM612 T.Y. B.Tech (Mech) **Maximum Points: 100**

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

12/7/22

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) Explain quenching and tempering of steels. b) Designate high tensile steel casting with ultimate tensile strength of 1030 N/mm^2. c) What is R20 series? Develop R20 series from 1 to 10. d) Write inference of 50 H8-g7. e) State and explain maximum shear stress theory of failure.	20	3	2	3.7.1
2	A knuckle joint is required to withstand a tensile load of 25 KN. Design the joint if the permissible stresses are σ_t = 56 N/mm^2, σ_c = 70 N/mm^2, τ = 40 N/mm^2.	20	1	5	5.4.1
3	a) Write Soderberg's equation and state its application to different types of loading. b) Explain fluctuating stress. Draw a stress time curve for fluctuating stress. c) A rectangular plate 50 mm X 10 mm with a hole 10 mm diameter is subjected to an axial load of 10 KN. Taking stress concentration into account, find the maximum stress induced.	05 05 10	1	3	5.4.2
4	A mild steel shaft transmits 15 KW at 210 rpm. It is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 24 teeth of 6 mm module is located 100 mm to the left of the right hand bearing and delivers the power horizontally to the right. The gear having 80 teeth of 6 mm module is located 15 mm to the right of left hand bearing and receives power in the vertical direction from below. Assuming an allowable working shear stress as 53 MPa, and a combined shock and fatigue factor of 1.5 in bending as well as in torsion, Determine the diameter of the shaft.	20	2	4	5.5.1
5	a) Design a leaf spring for the following specifications: Total load is 140 KN; Number of spring supporting the load is 4; Maximum number of leaves is 10; Span of the spring is 1000 mm; Permissible deflection is 80 mm. Take young's modulus as E=200 KN/mm^2 and allowable stress in spring material as 600 MPa.	10	2	4	5.4.2

	b) Design a concentric spring for an aircraft engine valve to exert a maximum force of 5000 N under a deflection of 40 mm. Both the springs have same free length, solid length and are subjected to equal maximum shear stress of 850 MPa. The spring index for both the springs is 6.	10			
6	a) Design a rubber belt to drive a dynamo generating 20 KW at 2250 r.p.m. and fitted with a pulley 200 mm diameter. Assume dynamo efficiency to be 85%. Allowable stress for belt=2.1 MPa, Density of rubber=1000 kg/m^3, Angle of contact for dynamo pulley=165^0, Coefficient of friction between belt and pulley=0.3. b) Derive the relation for the ratio of driving tensions of a V belt. c) Sketch and explain the simplex and duplex chains.	12 04 04	2	5	5.4 .1
7	a) Two plates of 10 mm thickness each are to be joined by means of a single riveted double strap butt joint. Determine the rivet diameter, rivet pitch, strap thickness and efficiency of the joint. Take the working stress in tension and shearing as 80 MPa and 60 MPa respectively. b) A 125 x 95 x 10 mm angle is welded to a frame by two 10 mm fillet welds, as shown in figure. A load of 16 KN is applied normal to the gravity axis at a distance of 300 mm from the centre of gravity of welds. Find maximum shear stress in the welds, assuming each weld to be 100 mm long and parallel to the axis of the angle.  All dimensions in mm. c) Determine the safe tensile load for bolts of M 20 and M 36. Assume that the bolts are not initially stressed and take the safe tensile stress as 200 MPa.	10 05 05	2	4	5.5 .1

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End Semester Examination May 2022 T.Y. B.Tech (Mech) Sem VI 17/5/22

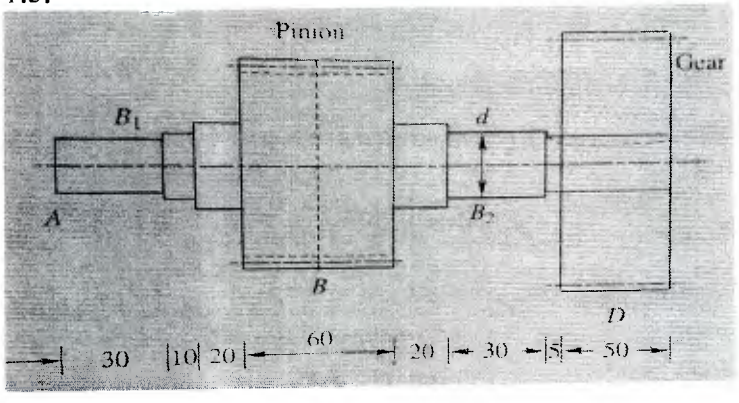
Program: B.Tech. Mechanical Engineering **Duration: 03 Hrs**

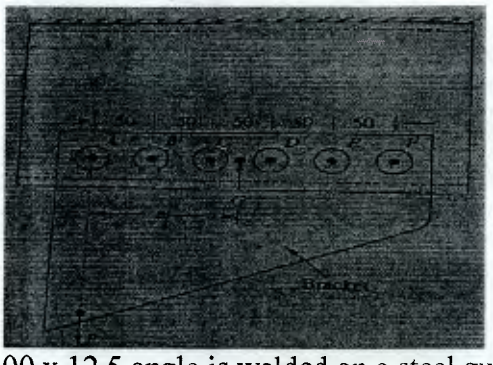
Course Code: PC–BTM612 **Maximum Points: 100**

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	3	2	3.7.1
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: σ_t = 50 N/mm^2, σ_c = 120 N/mm^2, τ = 40 N/mm^2.	20	1	5	5.4.1
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/mm^2 and at the same time, is subjected to an axial stress that varies from –15 to +30 N/mm^2. The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of steel FeE 400 (S_{ut} = 540 N/mm^2 and S_{yt} = 400 N/mm^2) and the corrected endurance limit of the shaft is 200 N/mm^2. Determine the factor of safety.	05 05 10	1	3	5.4.2

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, B_1 and B_2, 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 σ_{yt} = 360 MPa and FOS = 3. E = 205 X 10^3 KN/mm, and G = 80 KN/mm^2. Take K_b = 2.0 and K_t = 1.5.  	20	2	4	5.5 .1
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/mm^2. Leaves are pre stressed in such a way that when maximum force is applied, the stress in all leaves is 500 N/mm^2. 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	2	4	5.4 .2
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 transmission from high speed belt is 0.0118 KW per mm width per ply at V = 5 m/s. Take open belt drive system. b) Explain the procedure for selection of a standard V belt. c) What is polygon effect in chain drive? How this effect is minimized?	12 04 04	2	5	5.4 .1

	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	4	5.5.1

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RE EXAM JULY2022	
DATE:19-07-2022	SESSION: Afternoon
Class : Third Year B.Tech.in Mechanical Engineering Sem VI	Semester : [redacted] 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.

19/7/22

Q. NO	Question Statement	Points	Module	CO
Q1A	For the Electric ScootorManufacturing company, explore the applications of various principles, methodologies, tools and techniques of the Manufacturing Planning and control. Answer should include 1. Quality Control , Quality Assurance 2. Use of JIT / Lean Practices 3. Use of Lean Six Sigma practices 4. Use of Simulation for Inventory control 5. Uses of Industry 4.0 Technology for improved operations	10	M3, M4, M5, M6, M7	CO1 CO3
Q1B	State the Salient Features of 1. Market Survey and Forecasting 2. Capacity Planning 3. Manufacturing Requirement Planning 4. Material Requirement Planning 5. Master Production Scheduling	10	M1 M3 M4 M5	CO1 CO2 CO3
Q2A	State and explain the at least 5 Applications of Manufacturing Planning and control	10	M1	CO1, CO2
Q2B	Refer the Following Manufacturing Scenario of three machines and 7 jobs. Table shows the time required to process each job on the respective machine in min. Find the optimal sequence of jobs. Find Idle Time for each machine. Find Min Total Elapsed time.	10	M4	CO2 CO3

	JOB						
	A	B	C	D	E	F	G
Machine M1	10	7	6	5	7	9	4
Machine M2	6	7	10	6	5	4	8
Machine M3	10	14	12	14	11	12	13

State the seven waste as per JIT philosophy.

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 .

Cities	D1	D2	D3	D4	D5	D6
C1	10	11	17	21	15	10
C2	11	19	24	16	12	9
C3	12	12	17	9	8	10
C4	7	13	12	16	11	13
C5	9	13	15	9	10	16

10 | M7 | CO2

Q3B

Production facility Pi / City demand Di	P1	P2	P3	P4	Product Demand
D1	21	22	23	22	27
D2	18	23	21	15	16
D3	22	18	22	19	17
D4	23	21	24	19	21
D5	21	24	21	22	12
Supply Capacity	20	16	25	32	93

Transportation Problem : A Icecream manufacturing company has four production plants P1,P2,P3,P4 with production capacity of 20,16,25,32 (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 27,16,17,21,12 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.

10 | M7 | CO1 CO2

Q4A A company manufactured around 210scootors. Depending upon the availability of production resources daily production varies between 205to 213 mopeds, whose probability distribution is as follows:

Production per day	205	206	207	208	209	210	211	212	213
Probability	0.05	0.09	0.12	0.14	0.2	0.15	0.11	0.08	0.06

The finished scootors are transported in special lorry with 210 mopedscapacity. Use following random number array:82,89,78,24,53,61,18,45,04,23,50,77,27,54 and 10, simulate the process. Find average number of mopeds waiting in factory, Average waiting space in lorry.
State the limitations of simulation technique.

10 | M7, M3 | CO1, CO2, CO3

Q4B A firm manufactures two products A and B, both of which have to be processed on two machines M1 and M2. Product A requires 4 hours each on both machines and B requires 6 hours on machines M1 and 2 hours on machine M2. The available hours on machines M1 and M2 are 24 and 16 respectively . The profit per unit is estimated at Rs 120 for product A and 140 for product B. Find quantity of each product to be produced to maximize the profit.

10 | M6, M2 | CO1 CO2

	... constitute a project. The precedence relationship is as follows A< D; A<E; B<F; D<F; F < G, C<G; C<H; F<I; G<I. Draw the project network, find project duration ,find critical path. Refer the following project data. Task: A B C D E F G H I Time: 12 13 11 10 21 17 21 18 21 Find E and L for each event. Find EST, LST,EFT,LFT float for each activity.	10	M5	CO1, CO3
Q5B	Refer the Project Data as given in a table .The time estimates in weeks for PERT network of project are as follows Activity / to / tm / tp 1-2 / 2 / 4 / 9 1-3 / 3 / 6 / 10 1-4 / 2 / 4 / 11 2-5 / 3 / 5 / 7 3-5 / 4 / 6 / 14 4-6 / 5 / 7 / 11 5-6 / 4 / 8 / 15 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	10	M5	CO1, CO3
Q6A	Derive an expression for Economic Order Quantity of the (Basic model) of inventory.Derive an expression for Economic Batch Quantity of the of inventory. Explain the various Costs involved in inventory management.	10	M3	CO2, CO4
Q6B	Illustrate the Least Square method of Sales Forecasting with suitable Example. State and explain the types of error in forecasting.	10	M1	CO1, CO2
Q7	Write Short Notes on 1. Differentiate between CPM and PERT 2. Technologies used in Materials Management 3. Master Production Schedule 4. State the factors affecting the capacity of machine, Explore ways to eliminate these factors.	20	M1,M2, M3,M4 M5, M6 M7	CO1 C

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Munshi Nagar, Andheri (W) Mumbai – 400058

19/5/22

END SEM EXAM MAY2022	
Date: 19-05-2022	**Session: Afternoon**
Class : Third Year B.Tech.in Mechanical Engineering	**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.

Q. NO	Question Statement	Points	Module	CO
Q1	For the Electric Vehicle Manufacturing company, 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 small manufacturer employees 5 skilled men & 10 semi skilled men & makes an article in 2 Types a deluxe model & an ordinary model. The making of deluxe model requires 2hrs. by a skilled man & 2hrs by semi skilled man. The ordinary model requires 1hr work by skilled & 3hrs by semi skilled man. By union rules no man can work more than 48hrs/week in 6 working days of week. The manufacturer's clear profit on deluxe model is Rs.10 & ordinary model is Rs.8.It is identified based on previous experimental records that Deluxe and ordinary model units must be produced not less than 5 and 10 respectively. Deluxe and ordinary models produce 1 and 2 kg of industrial wastes respectively. According to the govt. norms these waste can not be produced more 30 kgs and 40 kg for deluxe and ordinary models respectively. Deluxe model needs 2units and Ordinary model needs 3 units of energy and permissible economical consumption of energy per week is 480 units. Determine the no. of units of deluxe model & ordinary model to maximize the profit. Solve it graphically. Assume suitable data if needed. **Attach the graph paper at the page of solution.**	10	M6	CO2

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

JOB							
	A	B	C	D	E	F	G
Machine M1	12	6	5	3	5	7	6
Machine M2	7	8	9	8	7	8	3
Machine M3	9	13	11	12	10	12	11

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

10 | M4 | CO2 CO3

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 .

Cities	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

10 | M7 | CO2

Q3B

Production facility Pi/ City demand Di	P1	P2	P3	P4	Product Demand
D1	23	25	19	29	26
D2	17	18	23	14	15
D3	25	15	28	18	19
D4	20	24	18	17	18
D5	26	19	25	20	11
Supply Capacity	19	15	24	31	89

Transportation Problem : A Icecream manufacturing company has four production plants P1,P2,P3,P4 with production capacity of 18,14,23,30 (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 25, 14, 18, 17, 11 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.

10 | M7 | CO1 CO2

Q4A A company manufactured around 200 mopeds. Depending upon the availability of production resources daily production varies between 197 to 205 mopeds, whose probability distribution is as follows:

Production per day	197	198	199	200	201	202	203	204	205
Probability	0.05	0.09	0.12	0.14	0.2	0.15	0.11	0.08	0.06

The finished mopeds are transported in special lorry with 200 mopedscapacity. Use following random number array:82,89,78,24,53,61,18,45,04,23,50,77,27,54 and 10, simulate the process .find average number of mopeds waiting in factory, Average waiting space in lorry.

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.

Part	Processing time	
	Lathe	Milling
A	10	18
B	25	12

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.

10 | M6, M2 | CO1 CO2

Q5A Task A,B,C,.....H,I constitue 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.

Task:	A	B	C	D	E	F	G	H	I
Time:	9	11	9	11	17	18	19	15	10

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

Differentiate between CPM and PERT

10 | M5 | CO1, CO3

Q5B The time estimates in weeks for PERT network of project are as follows

Activity	to	tm	tp
1-2	1	2	9
1-3	1	5	9
1-4	2	3	10
2-5	1	2	3
3-5	2	6	16
4-6	2	6	10
5-6	3	7	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 4 week earlier than expected time

10 | M5 | CO1, CO3

Q6A	Derive an expression for Economic Order Quantity of the (Basic model) of inventory. A company has the annual demand for a product as 96000 units. The Ordering cost per order is Rs22 and the Carrying cost of one unit in stock for a year is 18 percent. A supplier offers a quantity discount of 5percent on an order of at least 2000 units at a time and a discount of 10 percent on an order of at least 5000 units. Compute the most economic purchase quantity per order if the price of the product is Rs. 16 per unit.	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	10	0.19
2	5	0.14
3	9	0.17
4	7	0.19
5	17	0.29
6	18	0.31
7	19	0.28
8	15	0.24
9	17	0.31
10	23	0.48
11	18	0.38
12	10	0.21

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

Q7	Write Short Notes on 1. Functions of MPC 2. Technologies used in Materials Management 3. Master Production Schedule 4. Under Capacity Planning and Over Capacity Planning.	20	M1,M2, M3,M4 M5, M6 M7	CO1

*****

Standard Normal Probabilities

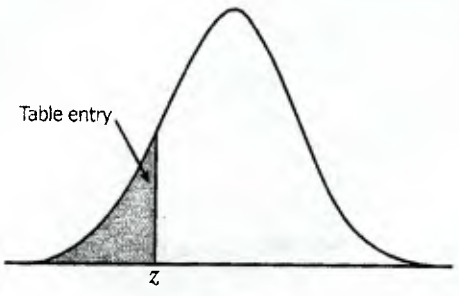

Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

Standard Normal Probabilities

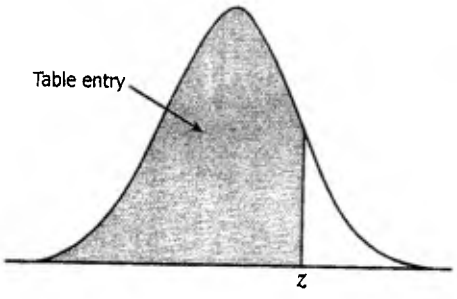

Table entry for z is the area under the standard normal curve to the left of z.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

30/5/22

BharatiyaVidyaBhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

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

End Semester Examinations

May 2022

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

Program: Mechanical Engineering **Duration: 03 Hrs.**

Course Code: PC BTM 614 **Maximum Points: 100**

Course Name: Internal Combustion Engines **Semester: VI**

Notes:

- **Question No. 1 is compulsory.**
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Points	CO	BL	PI
Q. 1	**Answer the following questions (any Four)**	**20**	1 - 3	1-7	1.2.1
a)	What do you mean by normal and abnormal combustion in S I Engines? What are the parameters that govern the normal combustion in S I Engine?				
b)	State and Discuss the important qualities of SI engine fuel.				
c)	How are I C Engines classified?				
d)	What are the functions of a nozzle? Draw a schematic diagram of Bosch type Fuel pump.				
e)	What are the main sources of pollutants from petrol engine? Discuss the adverse effects of emissions on human health.				
f)	Compare SI and CI engines with respect to: basic cycle, compression ratio, ignition, fuel used, and introduction of fuel.				
Q. 2 (A)	An experimental 4-Stroke gasoline engine of 1.7 litre capacity is to develop maximum power at 5000 rpm. The volumetric efficiency is 75% and the A/F ratio is 14:1. Two carburetors are to be fitted and it is expected that at maximum power the air speed at the choke is 100 m/s. The coefficient of discharge for the venturi is assumed to be 0.80 and that of main jet is 0.65. An allowance should be made for emulsion tube, the diameter of which can be taken as 1/3 of choke diameter. The gasoline surface is 6 mm below the choke at this engine condition. Calculate the sizes of a suitable choke and main jet. The sp. gr. of the gasoline is 0.75. Take atmospheric condition as 1	**10**	3	2	2.1.1

	bar and 300 K.				
(B)	Enumerate the requirements of fuel injection systems for C.I. engines. With a schematic diagram, explain the working of distributor type fuel injection system. What are its advantages and disadvantages?	**10**	2 & 3	3	1.2.1
Q. 3 (A)	An eight-cylinder, four stroke diesel engine has a power output of 386.4 kW at 800 rpm. The fuel consumption is 0.25 kg/kWh. The pressure in the cylinder at the beginning of injection is 32 bar and the maximum cylinder pressure is 55 bar. The injector is expected to be at 207 bar and the maximum pressure at the injector is set to be about 595 bar. Calculate the orifice area required per injector if the injection takes place over 12° crank angle. Assume the following: Specific gravity of fuel = 0.85; Coefficient of discharge for the injector = 0.6; atmospheric pressure = 1 bar; the effective pressure difference is the average pressure difference over the injection period.	**10**	3	3	2.2.2
(B)	Explain the two types of cooling systems and compare them.	**05**	4	4	2.1.1
(C)	Discuss the working principle of four stoke petrol engine with neat sketches.	**05**			
Q. 4 (A)	A Morse test on 12 cylinders, two stroke C.I. engine of bore 40 cm and stroke 50 cm, running at 200 rpm. The following results were obtained during test: Condition — Break load(N) — Condition — Break load (N)) All firing — 2040 — 7st cylinder — 1835 1st cylinder — 1830 — 8nd cylinder — 1860 2nd cylinder — 1850 — 9rd cylinder — 1820 3rd cylinder — 1850 — 10th cylinder — 1840 4th cylinder — 1830 — 11th cylinder — 1850 5th cylinder — 1840 — 12th cylinder — 1830 6th cylinder — 1855 — All firing — 2060 The output is obtained from dynamometer by using equation: BP= WN/180, Where, W= Break load in N and N= speed in rpm. Calculate IP, mechanical efficiency and BMEP.	**10**	4	4	3.1.1
(B)	Describe the Combustion Phenomenon in S I engines with help of p-ɵ diagram and explain each stages of combustion.	**10**	2	3	3.1.1
Q. 5 (A)	I) Explain Four stroke I.C. engine is always economical and less pollutant than two stroke I.C. Engine. What is the purpose of carrying out exhaust gas analysis?	**05**	1	5	2.1.1
	II) What are the different functions of lubricating systems? State the	**05**	1	6	2.1.1

	different lubricating systems used in I C Engines. Explain any one of them.				
(B)	The following observations were made during the test on oil engine : B.P. of the engine = 31.5 kW, Fuel used = 10.5 kg/hr, C.V. of the fuel = 43000 kJ/kg, Jacket circulating water = 540 kg/hr, Rise in temperature of cooling water = 56 °C Exhaust gases are passed through the exhaust gas calorimeter for finding the heat carried away by the exhaust gases. Water circulated through exhaust gas calorimeter = 454 kg/hr, Rise in temperature of water passing through exhaust gas calorimeter = 36°C, Temperature of exhaust gas leaving the exhaust gas calorimeter = 82°C, A/F ratio = 19.1, Ambient temperature = 17°C, Cp for exhaust gases = 1 KJ/kgK Draw up the heat balance sheet on minute and percentage basis.	**10**	4	4	2.2.2
Q. 6 (A)	An air compressor is being run by the entire output of a supercharged 4-stroke cycle diesel engine. Air enters the compressor at 25°C and is passed on to a cooler where 1210 kJ per minute is rejected. The air leaves the cooler at 65°C and 1.75 bar. Part of this air flow is used to supercharge the engine which has a volumetric efficiency of 72% based on induction manifold condition of 65°C and 1.75 bar. The engine which has six cylinders of 100 mm bore and 110 mm stroke runs at 2000 rpm and delivers an output torque of 150 Nm. The mechanical efficiency of engine is 80%. Determine : (i) The indicated mean effective pressure of the engine; (ii) The air consumption rate of the engine; (iii) The air-flow into compressor in kg per min.	**10**	4	3	2.1.1
(B)	**I)** A good CI engine fuel is a bad SI engine fuel and vice versa. Discuss the validity of the above statement in the light of the eight factors to reduce knocking in SI and CI engines. **II)** What are the different types of ignition systems used in I.C. engines? What are their advantages? Explain any one system in detail.	**05** **05**	2 2		1.3.1
Q. 7	**Write short note on following (any five)** **(A)** Advantages and disadvantages of using hydrogen in SI engine **(B)** The air pollution norms recently used and how alternating fuels are suitable of recent developed engines. **(C)** Five important efficiencies of IC engines with appropriate applications **(D)** Properties of good lubricant **(E)** Various methods of determining frictional power (FP) **(F)** Wankel engines **(G)** Solex carburetor with neat sketch with fuel circuit	**20**	2	1-7	1.3.1

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SARDAR PATEL COLLEGE OF ENGINEERING

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

Re-Exam Semester Examinations

JULY 2022

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

Program: Mechanical Engineering **Duration: 03 Hrs.**

Course Code: PC BTM 614 **Maximum Points: 100**

Course Name: Internal Combustion Engines **Semester: VI**

Notes: 11/7/22

- **Question No. 1 is compulsory.**
- Attempt **any Four questions** out of remaining six questions.
- Answers to all sub questions should be grouped together.
- All questions carry equal marks.
- Make suitable assumptions with proper explanations.

Q. No.		Points	CO	BL	PI
Q. 1	**Answer the following questions (any Four)**	**20**	1 - 3	1-7	1.2.1
a)	Discuss the factors to be considered for the design of combustion chambers of the diesel engine.				
b)	Explain the importance of alternatives fuels for I C Engine.				
c)	With the help of neat sketch discuss the constructions detail of spark plug.				
d)	Write short notes on Electric car vehicle.				
e)	Do I C Engines operate on a thermodynamic cycle? Draw the Otto cycle on p-V and T-s diagrams mark the various processes.				
f)	List three principal factors that influence engine performance? What is meant by the optimum spark advance?				
Q. 2 (A)	A simple jet carburetor is required to supply 6 kg of air per minute and 0.45 kg of fuel per minute of density 740 kg/m3. The air is initially at 1.013 bar and 27°C a) Calculate the throat diameter of the choke for flow velocity of 92 m/s. Velocity coefficient = 0.8. b) If the pressure drop across the fuel metering orifice is 0.75 of that at the choke, calculate the orifice diameter assuming Cd = 0.60.	**10**	3	2	2.1.1

(B)	Describe a battery ignition system with the help of sketch. What are the main disadvantages of a battery ignition system?	**10**	2 & 3	3	1.2.1
Q. 3 (A)	A three liter 4-stroke diesel engine develops 12 kW per m^3 of free air inducted per minute. The volumetric efficiency is 82% at 3600 rpm referred to atmospheric condition of 1bar and 27°C. A rotary compressor which is mechanically coupled to the engine is used to supercharge the engine. The pressure ratio and the isentropic efficiency of the compressor are 1.6 and 75% respectively. Calculate the percentage increase in brake power due to supercharging. Assume mechanical efficiency of the engine to be 85% and air intake to the cylinder to be at the pressure equal to delivery pressure from compressor and temperature equal to 5.7°C less than the delivery temperature of the compressor. Also assume that cylinder contains volume of charge equal to swept volume.	**10**	3	3	2.2.2
(B)	Explain the reasons for looking for alternate fuels for I C engines. Compare LPG and petrol as fuel for S I engines.	**05**	4	4	2.1.1
(C)	What is the importance of lubrication in I C engines? State the importance of engine friction.	**05**			
Q. 4 (A)	A 6-cylinder, 4-stroke C I engine develops 220 kW at 1500 rpm with BSFC of 0.273 kg/kWh. Determine the size of the single hole injector nozzle if the injection pressure is 160 bar and the pressure in the combustion chamber is 40 bar. The period of injection is 30° of crank angle. Take density of fuel as 860 kg/m^3 and orifice discharge coefficient = 0.9	**10**	4	4	3.1.1
(B)	The following data relate to the testing of a 4-stroke, 4-cylinder diesel engine: Bore = 36 cm, stroke = 40 cm, speed = 350 RPM, BP =257 kW, IMEP = 7 bar, fuel consumption = 72 kg/h, C.V. of fuel = 43960 kJ/kg, air consumption = 28.2 kg/min, mass of jacket cooling water = 86 kg/min, rise in temperature of jacket cooling water = 41°C, amount of piston cooling oil = 53 kg/min, temperature rise of cooling oil = 23°C, specific heat of cooling oil = 2.09 kJ/kg,K, room temperature = 20°C, exhaust gas temperature = 325°C, Cp of dry exhaust gas = 1.045 kJ/kgK, specific heat of water = 4.18 kJ/kg K. Draw up the heat balance sheet on kW and percentage basis. Calculate indicated, brake thermal and mechanical efficiencies.	**10**	2	3	3.1.1
Q. 5 (A)	Discuss the difference between theoretical and actual valve timing diagram of a 4-Stroke diesel engine. Compare the relative advantages and disadvantages of 4-Stroke and 2-Stroke cycle engines.	**10**	1	5	2.1.1

(B)	I) Why cooling of an I C engines is necessary? Why is over-cooling in an engine harmful? II) What are the basic requirements of a good injection system?	**10**	4	4	2.2.2
Q. 6 (A)	Describe the combustion Phenomenon in C I Engines with help of p-θ diagram and explain each stages of combustion.	**10**	4	3	2.1.1
(B)	**I)** Explain main functions of an injection pump with schematic diagram **II)** Describe and explain the essential parts of a modern carburetor with a neat sketch.	**05** **05**	2 2		1.3.1
Q. 7	**Write short note on following (any four)** **(A)** Explain the recent developments in IC engines like CRDI, ECU, GDI, HCCI. **(B)** Scavenging of two stroke engine **C)** Define the terms related to reciprocating I.C. Engines : (i) Stroke (ii) Bore (iii) Top Dead Centre (TDC) (iv) Clearance Volume (v)Displacement **D)** Explain firing order and how it is useful for design of ignition system? **E)** What do you mean by performance of I C engines? What is the purpose of Morse test? **F)** State and explain causes and problems of exhaust emissions.	**20**	2	1-7	1.3.1

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SARDAR PATEL COLLEGE OF ENGINEERING

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Munshi Nagar, Andheri (W) Mumbai – 400058

28/5/22

END SEMESTER – EVEN SEM – MAY 2022

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

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. Refer Annexures for additional information. Assume suitable data if necessary.
3. ***'a'*** is the single last digit (0 to 9) of student's registration no. in questions marked with *.

Q. No.	Questions	Points	CO	BL	PI
Q1 COMPULSORY	A) A student is studying for two courses 'Course-1' and 'Course-2'. Each course has a certain share of programming and reading components per hour of study as given in the following table. The table also gives the expected examination points obtainable per hour of study for each course based on past students' feedback.	(5)	3	4	2.1.3

	Study component's share per hour of study	
Study component	**Course-1**	**Course-2**
Programming	0.8 hr	0.2 hr
Reading	0.2 hr	0.8 hr
Expected points per hour of study	*1 points/hr*	*4 points/hr*

The student has an interest in coding and is ready to spend up to a total 30 hours in a semester on programming components whereas she can spend a maximum of 15 hours on reading. Formulate the optimization problem for the student to maximize the total points for both subjects taken together.

B) * 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 $\bar{X}$. (5) 1 3 2.4.1

$$f(x_1, x_2) = (a+3)x_1^2 x_2 - (3a+1)\frac{x_1^2}{x_2}$$

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.

	C) * Illustrate the bisection method by performing **one iteration** to find the minima of following function in the range (1,3). Use central difference method to numerically differentiate the function. $$f(x) = x^2 + \frac{a+10}{x}$$	**(5)**	*3*	*3*	*2.2.3*
	D) Discuss the following computational aspects of optimization: (i) Need of scaling the variables, (ii) Basis vector method to reduce size of problem, (iii) Information to be analyzed about the nature of problem before selecting a suitable software tool.	**(5)**	*2*	*2*	*2.2.3*
Q2	A) * Minimize following function using KKT method. $$(a+2)(x_1-10)^2 + (a+5)(x_2-10)^2$$ Subject to $$x_1 + x_2 - (a+5) \leq 0$$	**(10)**	*3*	*3*	*2.4.2*
	B) Prepare a comparison table to present differences in the features of following univariate optimization algorithms: (i) Exhaustive search method, (ii) Golden section method, (iii) Bisection method.	**(5)**	*1*	*3*	*2.2.3*
	C) * In Simulated Annealing (SA) algorithm, the Metropolis criterion and Boltzmann's probability distribution are used for a specific purpose; describe the purpose. Consider an iteration of SA where the value of temperature is 100. The objective function values for two successive points x_1 and x_2 are 100 and (200+a) respectively. The random number generated to apply the Metropolis criterion is (0.3+0.05*a). Determine if x_2 would be accepted as an optimal point during this iteration.	**(5)**	*3*	*3*	*2.2.3*
Q3	A) (i) Solve the optimization problem in Q1(A) using graphical method. (ii) Propose a situation which converts this problem to a non-linear programming problem.	**(5)**	*1*	*3*	*2.3.1*
	B) * Perform **one iteration** of unidirectional search using exhaustive search method to minimize following function. $$f(x_1, x_2) = -(7 + 0.25 \times a)x_1 - 15x_2 + 2x_1^2 + x_1x_2 + 5x_2^2$$ Consider starting point as $\begin{Bmatrix}0\\0\end{Bmatrix}$, search direction $\bar{s} = \begin{Bmatrix}1\\1\end{Bmatrix}$ and step size of 0.5. Give a recommendation for selecting the search direction at a given point.	**(8)**	*3*	*3*	*2.2.3*
	C) An optimization problem is defined as follows. Minimize $f(x_1, x_2) = (x_1-3)^2 + (x_2-3)^2$ Subject to $g_1(x_1, x_2)$: $x_1 + x_2 - p \leq 0$ For p=3, optimal solution is $x_1^* = 1.5, x_2^* = 1.5$. Obtain the sensitivity of $f(x_1, x_2)$ with respect to p.	**(7)**	*4*	*3*	*2.2.3*
Q4	A) Provide the standard form of linear programming (LP) problem. Explain the terms: basic variables, non-basic variables and constants with reference to the canonical form of a LP problem. How do you obtain the basic solution to a LP problem? Describe the motivation of the Simplex method.	**(5)**	*3*	*2*	*2.2.3*

	B) An integer programming problem is defined as follows. Maximize $f = (5 + \boldsymbol{a})x_1 + (9 + \boldsymbol{a})x_2$ Subject to $(4 + \boldsymbol{a})x_1 + (6 + \boldsymbol{a})x_2 \leq (75 + 20\boldsymbol{a})$ $(3 + \boldsymbol{a})x_1 - (6 + \boldsymbol{a})x_2 \leq (20 + 10\boldsymbol{a})$ $x_1, x_2 \geq 0$, 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 course of action with proper reasoning based on the BBM algorithm.	**(10)**	*2*	*3*	*2.3.1*
	C) (i) Compare between the Genetic Algorithm and the Particle Swarm Optimization algorithm. (ii) Compare between the deterministic and stochastic methods for optimization.	**(5)**	*1*	*3*	*2.2.3*
Q5	A) Describe different ways of classifying the optimization problems. Provide at least one example for each type of the problem.	**(5)**	*1*	*2*	*2.2.3*
	B) Explain the Lagrange Multiplier method to solve the optimization problems with equality constraints. Describe how this method can be extended to handle the problems with inequality constraints.	**(5)**	*1*	*2*	*2.2.3*
	C) Perform **two iterations** of Particle Swarm Optimization (PSO) algorithm to find the minima of following function in the range (1,3). Show detailed calculations for a typical case. $f(x) = x^2 + \frac{10}{x}$ • Use two particles with initial positions $x_1(0) = 1.1$ and $x_2(0) = 2.9$. • Inertial weight: $\theta = 1$ • Individual and group learning rates: $c_1 = c_2 = 2$ • Random number for individual particle, $r_1 = 0.2$ (both iterations) • Random number for group of particles, $r_2 = 0.6$ (both iterations)	**(10)**	*3*	*3*	*2.3.1*
Q6	A) Solve the optimization problem in Q1(A) using Simplex method.	**(10)**	*3*	*3*	*2.3.1*
	B) Discuss the Karush-Kuhn-Tucker (KKT) optimality conditions for obtaining the stationary point for a general optimization problem.	**(5)**	*1*	*2*	*2.2.3*
	C) 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: $\bar{x}^0 = (1,2)$, Initial range: $\bar{z}^0 = (2, 2)$	**(5)**	*3*	*3*	*2.3.1*

	• Range reduction factor: 0.25 • Generate random numbers using the scientific calculator.				
Q7	A) Describe the Simplex method using a detailed flowchart for the algorithm.	**(5)**	*3*	*2*	*2.2.3*
	B) * Apply Golden Section method to complete **one iteration** to find the minima of following function in the range (1,3). $$f(x) = x^2 + \frac{a+10}{x}$$	**(5)**	*3*	*3*	*2.2.3*
	C) * Answer following questions related to Genetic Algorithm (GA). • Find length of the binary string to represent a variable up to 3 decimal accuracy in the range of 1 to (10+***a***). • Following table gives information about the population existing at a particular iteration of GA. **Sr. No.** | **Binary string of member** | **Fitness** 1 | 10010 | 75+***a*** 2 | 01001 | 50+***a*** 3 | 00100 | 35+***a*** 4 | 11001 | 25+***a*** 5 | 00010 | 10+***a*** The random number generated by the proportionate reproduction operator is (0.3+0.045****a***). Which member will get selected? • For the population shown above, let member no. 1 and 2 be parents. Considering the position of crossover bit as 3, generate the offspring string. • Provide the new string if the offspring generated in the previous step is mutated at 3rd bit. • A Python code (partial) for implementing GA is provided in Annexure II. Analyze the code and answer the following. o In roulette wheel function, identify the line number where cumulative probability of each specimen is calculated. o Explain significance of variable `k` in line number 31. o 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*	*2.2.2*

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)

    # generating the random number to perform crossover
    k = random.randint(1, maxbits)
    # interchanging the genes
    for i in range(k, maxbits):
        xa_bin[i] = xb_bin[i]
    # generating the random number to perform crossover
    k = random.randint(1, maxbits)
    # interchanging the genes
    for i in range(k, maxbits):
        ya_bin[i] = yb_bin[i]

    x_new = int("".join(str(i) for i in xa_bin),2)/100.0
    y_new = int("".join(str(i) for i in ya_bin),2)/100.0

    return {"x": x_new, "y": y_new}

def mutate(individual):
    maxbits=11

    x = individual["x"]
    y = individual["y"]

    #convert real numbers with 2 decimals
    x_bin = convert_real_to_binary_list(x,maxbits)
    y_bin = convert_real_to_binary_list(y,maxbits)

    p_mut=0.005 # probability of mutation

     >>> code hidden <<<

    next_x = int("".join(str(i) for i in x_bin),2)/100.0
    next_y = int("".join(str(i) for i in y_bin),2)/100.0
    lower_boundary, upper_boundary = (-6, 6)
    # Guarantee we keep inside boundaries
    next_x = min(max(next_x, lower_boundary), upper_boundary)
    next_y = min(max(next_y, lower_boundary), upper_boundary)
    return {"x": next_x, "y": next_y}
```

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Munshi Nagar, Andheri (W) Mumbai – 400058

28/5/2022

Endsem May 2022

Programme: **Third Year B.Tech. in Mechanical/Civil/Electrical Engineering** Sem VI

Semester : **VI**

Course Name & Code: **Open Elective - Entrepreneurship Development and Start Up (OE-BTM613)**

Session: **Afternoon**

Time: **3 Hrs.**

Points: 100

Note:

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

Q. No.	Question	Points	CO/ MO	B.T. Level
1 a.	Define Entrepreneur as per French Economist J. B. Say? List different Qualities of an Entrepreneur.	02 03	01/01	01
1 b.	Distinguish Between Innovation and Invention.	05	01/02	01
1 c.	What is Market Research? List Different Techniques of Market Research?	02 03	02/03	01
1 d.	Give the Classification of MSME?	05	04/07	01
2 a.	Describe different types of Barriers to Entrepreneurship?	10	01/01	01
2 b.	Read the paragraph given below carefully. Define a Problem Statement from your understanding of the paragraph. Generate Ideas using SCAMPER and give atleast 1 example each, which solves the problem defined. **Paragraph:** According to (National Oceanic of Atmospheric Administration, US Dept.) NOAA's 2020 Annual Climate Report the combined land and ocean temperature has increased at an average rate of 0.13 degrees Fahrenheit (0.08 degrees Celsius) per decade since 1880; however, the average rate of increase since 1981 (0.18°C / 0.32°F) has been more than twice that rate. Based on NOAA's global analysis, the 10 warmest years on record have all occurred since 2005, and 7 of the 10 have occurred just since 2014. Looking back to 1988, a pattern emerges: except for 2011, as each new year is added to the historical record, it becomes one of the top 10 warmest on record at that time, but it is ultimately replaced as the "top ten" window shifts forward in time. The amount of future warming Earth will experience depends on how much carbon dioxide and other greenhouse gases we emit in coming decades. Today, our activities—burning fossil fuels and clearing forests—add about 11 billion metric tons of carbon to the atmosphere each year. According to	02 08	02/02 03/02	03, 06

	the 2017 U.S. Climate Science Special Report, if yearly emissions continue to increase rapidly, as they have since 2000, models project that by the end of this century, global temperature will be at least 5 degrees Fahrenheit warmer than the 1901-1960 average, and possibly as much as 10.2 degrees warmer. If annual emissions increase more slowly and begin to decline significantly by 2050, models project temperatures would still be at least 2.4 degrees warmer than the first half of the 20th century, and possibly up to 5.9 degrees warmer.			
3 a.	Explain the Market Research Procedure?	10	02/03	02
3 b.	What is Prototyping? Why is Prototyping Necessary?	10	02/04	01
4 a.	List different techniques of Market Research Methods What are the limitations of the Market Research Procedure?	04 06	02/03	01
4 b.	What is WIPO? What are its functions Match the Products with its Type of Intellectual Property?	06 04	04/05	01
5 a.	Given in the figure is the Regular Chair Prototype? Create atleast 5 ideas and Draw the Sketches of the ideas on the chair showing its function?	10	03/04	03, 06

Products	Intellectual Property
(a) Design of Musical Instrument	(1) Copyright
(b) Musical Lyrics	(2) Geographical Indication
(c) Logo of Music Company	(3) Patent
(d) Tanjore Veena	(4) Trademark

5 b.	What is Techno-Economic Feasibility? What are the contents of Feasibility Report?	10	04/06	01
6 a.	What is PCT? Why use PCT? What are its Advantages?	10	04/05	01
6 b.	What is the role of commercial banks in providing institutional finances to the SSIs? List commercial banks which provide financial support to the SSI and Start-Ups.	06 04	04/07	01
7 a.	What are different Technical Considerations required for Feasibility Report?	10	04/06	01
7 b.	What is Start-Up India Scheme? What are the objectives of the Start-Up India Scheme?	10	04/07	01

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28/5/22

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SARDAR PATEL COLLEGE OF ENGINEERING, MUMBAI

DEPARTMENT OF MECHANICAL ENGINEERING

END SEMESTER EXAMINATION, MAY 2022

T.Y. B.Tech Sem VI

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

Total Points: 100
Duration: 3 HOURS

Note:

- Answer any 5 question 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 a boundary value problem? Give an engineering application and explain. **20** CO/BL 2/3,4

Develop approximate solution for the following problem using **Shooting Method**.

$$\frac{d^2y}{dx^2} - 2y = 8x(9-x), \qquad y(0)=0 \text{ and } y(9)=0$$

Take a step size as 3 and show the data in tabular form with calculation steps.

Q2. What is least square regression analysis? Explain. **20** 1,2/1,3

Following table shows the thermal expansion coefficient with the temperature.

Temp °C	30	60	100	150	200	300	400
α(mm)/°C	2	3	4	5	6	7	8

Regress the data to a **second order polynomial**.

Q3. Differentiate between IVP and BVP with real life example. Name single step and multi-step method (2 methods for each). **20** 2,3/1,4

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 $y_{exact} = 3t^2 + 6t + 6 - 5e^t$.

Q4. How Taylor series helps to find numerical derivatives. State different schemes with sufficient representation of first order and second order derivative term. Also mention their order of accuracy. **20** 1,2,3 /1,2,3

The velocity of particle which starts from the rest is given below

T (sec)	0	2	4	6	8	10	12	14	16	18	20
V (m/s)	0	16	29	40	46	51	32	18	8	3	0

Q5. What is the significant of numerical interpolation in engineering? Name any three numerical techniques. **20** 1,3 /1,3,4

Construct Newton's divided difference polynomial of second order using following data. Also comment on nature of possible polynomial based on difference table.

x	1	0.2	0.4	0.6	0.8	1	1.2
f(x)	0	0.0016	0.0256	0.1296	0.4096	1	2.0736

Q6. State limitations of Newton Raphson method. **20** 1,2/3,4
Solve for one of the roots of the following equation by the Newton Raphson method and compare the result with secant method.

$$x^3 - 6x^2 + 8x + 0.8 = 0$$

Analyse the rate of convergence.

Q7. Solve the following system of equations correct to two decimal places. **20** 1,2,3 /3,4

$$2.412x_1 + 9.879x_2 + 1.564x_3 = 4.89$$

$$1.876x_1 + 2.985x_2 + 11.62x_3 = -0.972$$

$$12.214x_1 + 2.367x_2 + 3.672x_3 = 7.814$$

Use following methods to formulate and compare the result,

a. Gauss–Jacobi method
b. Gauss–Seidel method

Show result in tabular form for **minimum six iterations.**

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(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

Re-Examinations July 2022

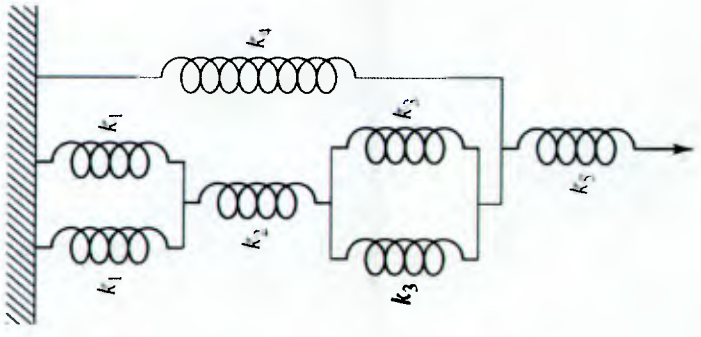
Program: T. Y. B Tech (Mechanical Engg.) Sem VI **Duration:** 3 hr

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

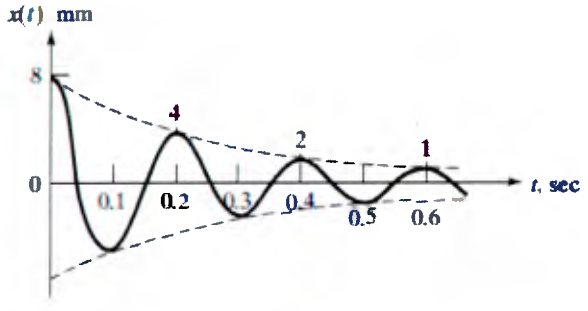
Course Name: Mechanical Vibration **Semester:** VI

14/7/22

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	PI
1	a) What is meant by Beats phenomenon? Draw amplitude versus time diagram and explain the various terms involved in it. b) Material property like young's modulus can be obtained by knowing natural frequency of the system. Explain with suitable example. c) Write the expression for *displacement transmissibility*; explain the same with suitable figure. d) Determine the equivalent spring stiffness for the system shown. (k_1 = 300 kN/m, k_2 = 450 kN/m, k_3 = 550 kN/m, k_4 = k_5 =500 kN/m 	5 5 5 5	1, 2	2, 3	2.4
2	a) Consider a spring mass damper system with $k = 8\frac{kN}{m}$, $m = 20\ kg, and\ c = 80N - \frac{s}{m}$. Find the steady state response of the system under the harmonic force $F(t) = 400Cos(10t)\ N$ b) A spring-mass system is set to vibrate from zero initial conditions under a harmonic force. The response is found to exhibit the phenomenon of beats with the period of beating and oscillation equal to 0.5s and 0.05s resp. Find the natural frequency of the system and the frequency of the harmonic force.	10 10	3	4	

Re-Examinations July 2022

3	a) Determine the displacement, velocity, and acceleration of the mass of a spring-mass system with, k = 500 N/m, M = 20 kg, and i) $x_0 = 0$ m, $dx_0/dt = 5$ m/s , ii) $x_0 = 0.1$ m, $dx_0/dt = 0$ m/s	10	1, 2	2, 3	2.4
	b) The free-vibration responses of an electric motor of weight 981 N mounted on the foundation is shown in Fig. Identify the following: (i) the spring constant and damping constant of the foundation, and (ii) the undamped and damped natural frequencies of the electric motor. 	10			
4	a) A weight of 100 N is suspended from a spring of stiffness 4000 N/m and is subjected to a harmonic force of amplitude 120 N and frequency 6 Hz. Find (i) the extension of the spring due to the suspended weight, (ii) the static displacement of the spring due to the maximum applied force, and (iii) the amplitude of forced motion of the weight.	6	2	3	2.3 .2
	b) State assumptions made and derive the equation of fundamental frequency for the Dunkarley method.	10	3	4	
	c) Define the term *"magnification factor"*, how it is related to frequency ratio? Explain with suitable diagram.	4	3	4	
5	a) An automobile is modeled as a single-degree-of-freedom system vibrating in the vertical direction. It is driven along a road whose elevation varies sinusoidally. The distance from peak to trough is 0.2 m and the distance along the road between the peaks is 35 m. If the natural frequency of the automobile is 2 Hz and the damping ratio of the shock absorbers is 0.15, determine the amplitude of vibration of the automobile at a speed of 60 km/hour. If the speed of the automobile is varied, find the most unfavorable speed for the passengers.	6+8	1, 2, 3	4	2.2
	b) Write the expression for forced equation of motion of a viscously damped system, Draw in a vector diagram representing same	6			

Re-Examinations July 2022

6	a) The mass and stiffness matrices and the mode shapes of a two-degree-of-freedom system are given by $[m] = \begin{bmatrix} 1 & 0 \\ 0 & 4 \end{bmatrix}$, $[k] = \begin{bmatrix} 12 & -k_{12} \\ -k_{12} & k_{22} \end{bmatrix}$, $\bar{X}^{(1)} = \begin{Bmatrix} 1 \\ 91109 \end{Bmatrix}$, $\bar{X}^{(2)} = \begin{Bmatrix} -91109 \\ 1 \end{Bmatrix}$ If the first natural frequency is given by $\omega 1 = 1.70\ rad/s$ determine the stiffness coefficients and the second natural frequency of vibration. b) Find the free-vibration solution of a cord fixed at both ends when its initial conditions are given by, $w(x, 0) = 0, \quad \frac{\partial w}{\partial t}(x, 0) = \frac{2ax}{l}$ for $0 \le x \le \frac{l}{2}$ $\frac{\partial w}{\partial t}(x, 0) = 2a\left(1 - \frac{x}{l}\right)$ for $\frac{l}{2} \le x \le l$	10 10	3 3	4 4	2.3.2
7	Answer the following: a) The measurement of vibration has become necessary, Why? (list any five point). b) Draw flow-diagram of basic vibration measurement scheme. Discuss the function of each block. c) What are the different types of frequency measuring instrument? Explain any one of them. d) How does a continuous system differ from a discrete system in the nature of its equation of motion?	20	4	3,4	2.3.1

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End-Sem Examinations May 2022

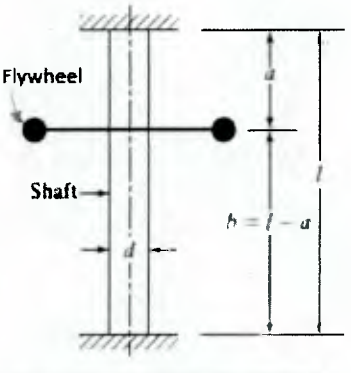
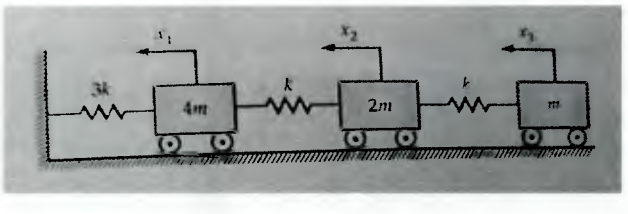
25/5/22

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

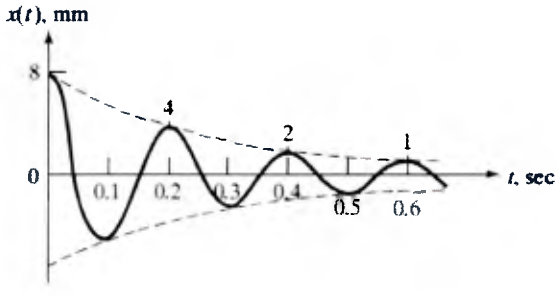
Course Code: PE-BTM518 **Maximum Points:** 100

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

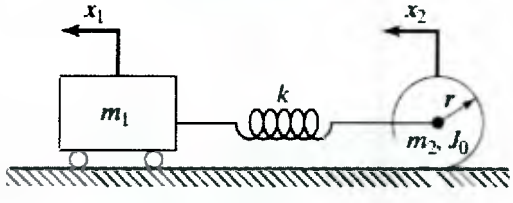
1. Q. no. 1 is compulsory, solve any four out of remaining.
2. Answers to each sub-questions must be grouped together
3. Use of scientific calculator is allowed
4. Begin answer to each question on new page.
5. Candidates should write the answers legibly

Q.No.	Questions	Pts	Co	BL	PI
1	a) A damper offers resistance 0.12 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 = 3 kg, *i.* Natural time period, τ *ii.* Damped frequency, ω_d *iii.* Critical damping constant, *cc* *iv.* Damping ratio, ξ *v.* Logarithmic decrement, δ	5			
	b) A flywheel is mounted on a vertical shaft, as shown in Fig. The shaft has a diameter d and length l and is fixed at both ends. The flywheel has a weight of W and a radius of gyration of r. Find the natural frequency of the longitudinal vibration of the system. 	5			
	c) Obtain the influence coefficient matrix for the system shown in 	5	1,2	2,3	2.4

End-Sem Examinations May 2022

	d) 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 an 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.	5			
2	a) Determine the displacement, velocity, and acceleration of the mass of a spring-mass system with, k = 500 N/m, M = 2 kg, and x_0 = 0.1 m, dx_0/dt = 5 m/s. b) The free-vibration responses of an electric motor of weight 500 N mounted on the foundation is shown in Fig. Identify the following: (i) the spring constant and damping constant of the foundation, and (ii) the undamped and damped natural frequencies of the electric motor. 	8 12	1,2	2,3	2.4
3	a) A weight of 50 N is suspended from a spring of stiffness 4000 N/m and is subjected to a harmonic force of amplitude 60 N and frequency 6 Hz. Find (i) the extension of the spring due to the suspended weight, (ii) the static displacement of the spring due to the maximum applied force, and (iii) the amplitude of forced motion of the weight. b) Consider a spring mass damper system with $k = 4000\frac{N}{m}$, $m = 10\ kg, and\ c = 40N - \frac{s}{m}$. Find the steady state response of the system under the harmonic force $F(t) = 200Cos(10t)\ N$. *and initial condition* $x0 = 0.1m\ and\ \dot{x}0 = 0$ c) Give any three examples for harmonically excited system. d) Define the term *"magnification factor"*, how it is related to frequency ratio?	6 10 2 2	2 3 3 2	3 4 4 2	2.3.2
4	a) An automobile is modeled as a single-degree-of-freedom system vibrating in the vertical direction. It is driven along a road whose elevation varies sinusoidally. The distance from peak to trough is 0.2 m and the distance along the road between the peaks is 35 m. If the natural frequency of the automobile is 2 Hz and the damping ratio of the shock absorbers is 0.15, determine the amplitude of vibration of the automobile at a speed of 60 km/hour. If the speed of the automobile is varied, find the most unfavorable speed for the passengers. b) Explain the "*displacement transmissibility*".	6+8 3	1,2,3	4	2.2

End-Sem Examinations May 2022

	c) Show the various terms in the forced equation of motion of a viscously damped system in a vector diagram.	3			
5	a) The mass and stiffness matrices and the mode shapes of a two-degree-of-freedom system are given by $[m] = \begin{bmatrix} 1 & 0 \\ 0 & 4 \end{bmatrix}$, $[k] = \begin{bmatrix} 12 & -k_{12} \\ -k_{12} & k_{22} \end{bmatrix}$, $\overline{X}^{(1)} = \begin{Bmatrix} 1 \\ 9.1109 \end{Bmatrix}$, $\overline{X}^{(2)} = \begin{Bmatrix} -9.1109 \\ 1 \end{Bmatrix}$ If the first natural frequency is given by $\omega 1 = 1.70\ rad/s$ determine the stiffness coefficients and the second natural frequency of vibration. b) Determine the equations of motion and the natural frequencies of the system shown in Fig 	10 10	3 1,2	4 4	2.3.2
6	Answer the following: a) The measurement of vibration has become necessary, Why? (list any five point). b) Draw flow-diagram of basic vibration measurement scheme. Discuss the function of each block. c) What are the different types of frequency measuring instrument? Explain any one of them. d) How does a continuous system differ from a discrete system in the nature of its equation of motion?	20	4	3,4	2.3.1
7	a) Find the free-vibration solution of a cord fixed at both ends when its initial conditions are given by, $w(x, 0) = 0, \quad \frac{\partial w}{\partial t}(x, 0) = \frac{2ax}{l}$ for $0 \le x \le \frac{l}{2}$ $\frac{\partial w}{\partial t}(x, 0) = 2a\left(1 - \frac{x}{l}\right)$ for $\frac{l}{2} \le x \le l$ b) State assumptions made and derive the equation of fundamental frequency for the Dunkarley method.	10 10	3 1	4	2.4

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Re _Exam - July 2022

Program: Mechanical T.Y. B.Tech (Mech) Sem VI **Duration: 3 Hrs**

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

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

Notes: Assume suitable data whenever necessary

14/7/22

Solve [Any Five]

Q.No.	Questions	Points	CO	BL	PI
1a	Explain the relative importance of basic materials in a historic context and Why Composite material is preferred over steel, justify with example	10	1	I	1.5.1
1b	Why most of the composite material is in the fibre form and Classify Composite material	10	1	II	5.4.1
2a	Explain different types of fibres and Explain different types of Matrix	10	2	II	1.6.1
2b	Explain the Metal Matrix Composites in detail and Explain the Ceramic Matrix Composites in detail	10	2	II	5.4.1
3a	Explain the Polymer Matrix Composites in detail	10	3	III	5.4.1
3b	Justify the need of 'Strain Compatibility'	10	4	II	5.4.1
4a	Discuss the Deformation and relative displacement vector	10	4	III	1.6.1
4b	Discuss the Stress Tensor	10	4	III	5.4.1
5a	Discuss the Equilibrium using Force Balance & Moment Balance	10	4	VI	1.6.1

Re _Exam - July 2022

5b	Discuss composite post processing operations in brief	10	3	VI	1.6.1
6a	Explain pultrusion and Autoclave moulding process in composites	10	3	I	5.4.1
6b	Discuss the hand lay up and spray lay up	10	3	III	5.4.1
7a	Discuss material consideration in product design in composite	10	4	III	5.4.1
7b	Explain various industrial applications of Composite material	10	3	III	1.6.1

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25/5/22

End Sem - May 2022 Examinations

T.Y. B. Tech (Mech) Sem II

Program: Mechanical **Duration: 3 Hrs**

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

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

Notes: Assume suitable data whenever necessary

Q.No.	Questions	Points	CO	BL	PI
1a	**Identify** different applications of composite material with suitable examples	10	1	I	1.5.1
1b	**Explain** the Glass fiber manufacturing with schematic diagram	10	3	II	5.4.1
2a	**Describe** different natural fibers and role of matrix in the fibers	10	2	II	1.6.1
2b	**Explain** different manufacturing process of composite material	10	3	II	5.4.1
3a	**Discuss** pultrusion and Autoclave moulding process in composites	10	3	III	5.4.1
4a	**Describe** the most Metal Matrix composites and its advantages and disadvantages	10	1	II	5.4.1
4b	**Show** the typical properties of ceramic metal matrix composites and its applications	10	2	III	1.6.1
5a	**Demonstrate** the application of silicon carbide matrix composites and manufacturing process SCM	10	3	III	5.4.1
5b	**Create** the term deformation in composite and obtain strain tensor	10	4	VI	1.6.1
6a	**Formulate** the term Stress Tensor	10	4	VI	1.6.1

End Sem - May 2022 Examinations

7a	**Show** the hand lay up and spray lay up	10	3	I	5.4.1
7b	**Demonstrate** composite post processing operations in brief	10	4	III	5.4.1

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END SEM EXAMINATION, May-2022

T.Y. B.Tech (Mech) Sem VI 25/5/22

Program: **B. Tech. in Mechanical Engineering** Date: **25 May 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) Differentiate:** between Administration and Management of an organisation. **Discuss:** Process of Management in an organisation.	(10)	1	1	IV,V	9.1.1
	B) Explain: Various functions of Management in an organisation.	(10)	1	1	II	9.1.1
2.	**A) Describe:** Types of techniques of motivation. **Illustrate:** With example motivation techniques practised in an industry.	(10)	1,2	2	II,III	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,III	9.1.1
3	**A) Explain:** Assumptions and limitations in break-even analysis. ABC Industries Ltd. provides the following data of its operations. Selling price per article = Rs.10/-, Variable Cost per article = Rs.6/, Fixed Cost = Rs. 80,000/-. **Construct:** Break-even chart and **Determine:** Break-even point. Carry out analysis starting with 0 units of sale, to the output units of 30000 in increments of 5000 units.	(10)	2	3	II, III,V	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. **Justify:** *An enterpreneur differs from a manager* by describing 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 of implememtation of ERP in industry.	(10)	4	7	II	9.1.1
7	**Expalin: ANY THREE** of the following in brief:	(20)			II	9.1.1
	A) Managerial Skills		1	1		
	B) ERG Theory of motivation		1	2		
	C) Methods of Depreciation		2	3		
	D) Financial Statements		2	4		
	E) ERP-II		4	7		

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End Semester Examinations - May 2022 Examinations

25/5/22

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	PI
1	Prototype consists of triangular pyramid is to be develop using following RP processes (i) Scanning Type Stereolithography (ii) Bulk lithography (iii) Laminated Object Manufacturing (iv) Selective Inhibition Sintering Triangular 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	4.5.1
2 (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	3.8.1
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	10	1	4	3.8.1

	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).				
3 (A)	Explain stereolithography with neat sketches	10	2	5	3.1.1
3 (B)	With neat sketches explain constraint surface microstereolithography (MSL)? Discuss advantages and issues with constraint surface MSL.	10	1	1	1.6.1
4 (A)	With neat sketch explain design of flexural mechanism for XY scanning system	10	3	2	3.1.1
4 (B)	With neat sketch explain shape deposition manufacturing process. Take suitable part geometry to explain processes involved in shape deposition manufacturing.	10	1	3	1.6.1
5(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	3.1.1
5(B)	With neat diagram explain Multi-jet modeling process.	10	2	4	1.6.1
6(A)	Explain various methods to avoid stair-stepping effects in Additive Manufacturing processes	10	1	4	4.5.1
6(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	2.8.1
7(A)	Explain .stl and amf file format and its importance.	10	2	1	1.6.1
7(B)	What is amorphous material? Discuss its behavior on volume against Temperature diagram. List few amorphous materials used in RPT.	10	3	2	3.1.1

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Reexaminations - JULY 2022 Examinations

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

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**

14/7/22

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	PI
1	Explain following processes with neat sketches (i) Bulk Lithography (ii) Stereolithography (iii) Fused Deposition Modeling (iv) LOM	20	1, 2,3,4	6	4.5.1
2 (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	3.8.1
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	3.8.1
3 (A)	Explain (i) challenges involved in microstereolithography compared with stereolithography (ii) design of flexural	10	2	5	3.1.1

	mechanism for XY scanning system				
3 (B)	With neat sketches explain constraint surface microstereolithography (MSL)? Discuss advantages and issues with constraint surface MSL.	10	1	1	1.6.1
4 (A)	Explain AM process plan with neat diagram	10	3	2	3.1.1
4 (B)	With neat sketch explain shape deposition manufacturing process. Take suitable part geometry to explain processes involved in shape deposition manufacturing.	10	1	3	1.6.1
5(A)	Explain steps suggested by Mueller for selecting the proper type of material for additive manufacturing.	10	4	4	3.1.1
5(B)	With neat diagram explain the post processing method suitable for micro-voxels obtained from unconstraint depth photopolymerization.	10	2	4	1.6.1
6(A)	Explain various methods to avoid stair-stepping effects in Additive Manufacturing processes	10	1	4	4.5.1
6(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	2.8.1
7(A)	Explain ASCII and amf file format and its importance.	10	2	1	1.6.1
7(B)	What is amorphous material? Discuss its behavior on volume against Temperature diagram. List few amorphous materials used in RPT.	10	3	2	3.1.1

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End Semester Examination May 2022

T.Y. B.Tech (Mech) Sem VI 27/5/22

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

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

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

Instructions:

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	PI
1(a)	Discuss the effect of evaporator pressure and condenser pressure on performance of vapour compression cycle.	05	1	1	1.4.1
1(b)	Discuss about thermodynamic wet bulb temperature and wet bulb temperature.	05	1	1	1.4.1
1(c)	Define Effective temperature. Enlist the factors governing effective temperature.	05	3	1	1.4.1
1(d)	Moist air enters a chamber at 7°C DBT and 2.5°C thermodynamic WBT at a rate of 100 cmm. The barometric pressure is 1.01325 bar. While passing through the chamber, the air absorbs sensible heat at the rate of 100 kW and pics up 50 kg/h of saturated steam at 150°C. Determine the dry and wet bulb temperature of leaving air.	05	4	2	2.4.1
2(a)	A R-134a vapour compression system at a condenser temperature of 40° C and an evaporator temperature of 0° C develops 15 tons of refrigeration. Using p-h diagram for R-134a, determine (i) The discharge temperature and mass flow rate of the refrigerant circulated, (ii) The theoretical piston displacement of the compressor and piston displacement per ton of refrigeration, (iii) The theoretical horsepower of the compressor and horsepower per ton of refrigeration, (iv) The heat rejected in the condenser, and (v) The Carnot COP and actual COP of the cycle.	12	2	3	2.4.1
2(b)	Draw schematic diagram and T-s diagram of reduced ambient aircraft refrigeration system and explain its working. Also write an expression for COP of the system.	08	1	2	1.4.1

3(a)	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.	10	3	3	2.4.1
3(b)	Describe in detail all the desirable properties an ideal refrigerant.	10	1	2	1.4.1
4(a)	A sample of moist air is at 37°C DBT and 30°C WBT. If barometric pressure is 700 mm of Hg. Calculate followings for a sample of air without making use of psychrometric chart (i) Relative humidity (ii) Humidity ratio (iii) Dew point temperature (iv) Density and (v) Enthalpy.	10	1,2	3	2.4.1
4(b)	Discuss mechanism of body heat loss and explain mathematical model of heat exchange between man and environment.	10	3	1	1.4.1
5	In an industrial application for winter air conditioning an air washer is used with heated water spray followed by a reheater. The room sensible heat factor may be taken as unity. The design conditions are: Outside: 0°C DBT and dry Inside :22°C DBT and 50% RH Room heat loss: 703 kW The following quantities are known from the summer design. Ventilation air: 1600 cmm Supply air: 2800 cmm Spray water quantity: 500 kg/min The air washer saturation efficiency is 90 percent. The make-up water is available at 20°C. Calculate (i) The supply air condition to space (ii) The entering and leaving air conditions at the spray chamber. (iii) The entering and leaving spray water temperatures. (iv) The heat added to the spray water. (v) The reheat, if necessary.	20	4	3	2.4.1
6(a)	Explain practical single effect water-lithium bromide absorption chiller with neat sketch.	12	1	1	1.4.1
6(b)	Explain various methods of duct design.	08	3	1	1.4.1
7(a)	What is effective temperature? Explain what comfort chart is and also explain human comfort.	10	3	1	1.4.1
7(b)	Draw a neat sketch of T-s and p-v diagram of actual vapour compression cycle and explain how it is different than simple saturation vapour compression cycle.	10	1	1	1.4.1

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Re- Examination July 2022

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

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

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

Course Name: Refrigeration and Air-Conditioning **Semester: VI** 15/7/22

Instructions:

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	PI
1(a)	Explain use of liquid vapour regenerative heat exchanger in vapour compression refrigeration system.	05	1	1	1.4.1
1(b)	Compare primary refrigerants and secondary refrigerants.	05	1	1	1.4.1
1(c)	Compare window air conditioner and split air conditioner.	05	1	1	1.4.1
1(d)	Define following terms: (i) Humidity ratio (ii) Relative Humidity (iii) Degree of saturation (iv) Dew point temperature (v) Wet bulb temperature	05	3	1	2.4.1
2(a)	Discuss bootstrap aircraft refrigeration system by drawing schematic diagram and temperature entropy diagram.	08	1	1	2.4.1
2(b)	A R-134a vapour compression system operating at a condenser temperature of 45°C and evaporator temperature of 0°C develops 15 tons of refrigeration. Using p-h diagram (chart) for R-134a, determine (i) the discharge temperature and mass flow rate of the refrigerant circulated (ii) the theoretical piston displacement of the compressor and piston displacement per ton of refrigeration (iii) the theoretical horsepower of the compressor and horsepower per ton of refrigeration (iv) the heat rejected in the condenser and (v) the Carnot COP and actual COP of the cycle.	12	2	2	1.4.1
3(a)	Describe in detail the designation system of refrigerants.	10	3	1	2.4.1
3(b)	Draw neat sketch of actual vapour compression cycle with p-h and T-S diagrams and explain it in detail.	10	1	1	1.4.1

4(a)	A sample of moist air is at 30°C DBT and 20°C WBT. If barometer pressure is 740 mm of Hg. Calculate for sample of air without using psychrometric chart. (i) Relative humidity (ii) Humidity ratio (iii) Dew point temperature (iv) Density and (v) Enthalpy	10	3	2	2.4.1
4(b)	Explain in detail the various methods of duct design.	10	3	1	1.4.1
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. Determine: (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	2.4.1
6(a)	Draw neat sketch of comfort chart and explain it in detail also explain human comfort.	10	3	1	1.4.1
6(b)	Draw neat sketch of three-fluid refrigeration system and explain it in detail.	10	3	1	1.4.1
7(a)	Discuss mechanism of body heat loss and explain mathematical model of heat exchange between man and environment.	10	3	1	1.4.1
7(b)	Discuss about various pressure losses occurring in air distribution system.	10	3	1	1.4.1

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SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

Re- Examination July 2022

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

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

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

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

15/7/22

Instructions:

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	PI
1(a)	Explain use of liquid vapour regenerative heat exchanger in vapour compression refrigeration system.	05	1	1	1.4.1
1(b)	Compare primary refrigerants and secondary refrigerants.	05	1	1	1.4.1
1(c)	Compare window air conditioner and split air conditioner.	05	1	1	1.4.1
1(d)	Define following terms: (i) Humidity ratio (ii) Relative Humidity (iii) Degree of saturation (iv) Dew point temperature (v) Wet bulb temperature	05	3	1	2.4.1
[illegible])	Discuss bootstrap aircraft refrigeration system by drawing schematic diagram and temperature entropy diagram.	08	1	1	2.4.1
2(b)	A R-134a vapour compression system operating at a condenser temperature of 45°C and evaporator temperature of 0°C develops 15 tons of refrigeration. Using p-h diagram (chart) for R-134a, determine (i) the discharge temperature and mass flow rate of the refrigerant circulated (ii) the theoretical piston displacement of the compressor and piston displacement per ton of refrigeration (iii) the theoretical horsepower of the compressor and horsepower per ton of refrigeration (iv) the heat rejected in the condenser and (v) the Carnot COP and actual COP of the cycle.	12	2	2	1.4.1
3(a)	Describe in detail the designation system of refrigerants.	10	3	1	2.4.1
3(b)	Draw neat sketch of actual vapour compression cycle with p-h and T-S diagrams and explain it in detail.	10	1	1	1.4.1

4(a)	A sample of moist air is at 30°C DBT and 20°C WBT. If barometer pressure is 740 mm of Hg. Calculate for sample of air without using psychrometric chart. (i) Relative humidity (ii) Humidity ratio (iii) Dew point temperature (iv) Density and (v) Enthalpy	10	3	2	2.4.1
4(b)	Explain in detail the various methods of duct design.	10	3	1	1.4.1
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. Determine: (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	2.4.1
6(a)	Draw neat sketch of comfort chart and explain it in detail also explain human comfort.	10	3	1	1.4.1
6(b)	Draw neat sketch of three-fluid refrigeration system and explain it in detail.	10	3	1	1.4.1
7(a)	Discuss mechanism of body heat loss and explain mathematical model of heat exchange between man and environment.	10	3	1	1.4.1
7(b)	Discuss about various pressure losses occurring in air distribution system.	10	3	1	1.4.1

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25/5/22

END SEMESTER EXAMINATION MAY 2022

Program: Mechanical Engineering T.Y. B. Tech (Mech) Sem VI Duration: 3 hour

Course Code: **PE-BTM 537** Maximum Points: 100

Course Name: **Tool Engineering** Semester: VI

INSTRUCTIONS:

1. Question number 1 is compulsory & Attempt any four questions out of remaining six questions.
2. Draw neat schematic diagrams wherever necessary, **highlight** important points of answer.
3. Assume suitable data if necessary and mention it.

Q.No.	Questions	Point	CO	BL	PI
Q1 A)	During orthogonal outer diameter (O.D.) turning of 'SS314' tube having O.D. 35 mm on lathe machine. Refer the following input data- Rake angle of tool is 35°, Cutting velocity (V_c) is 15 m/min, feed is 0.1 mm/revolution of workpiece, length of continuous chip in one revolution is 50.72 mm, cutting force is 200kgf, feed force is 80 kgf. Calculate- Shear plane angle, Coefficient of friction, velocity of chip along tool face and chip thickness?	10	1	3	1. 2. 1
Q1 B)	How can forming limit diagram (FLD) can be formed using a set of specimens? Give significance to each region's FLD and draw labeled test setup?	10	3	2	2. 1. 2
Q2 A)	Explain different tool geometry features of a single point cutting tool with the help of a neat sketch?	5	2	1	1. 2. 1
B)	Determine value of orthogonal rake angle, inclination angle, maximum rake angle of a turning tool, whose geometry is specified as per ASA system as, [10° , -10° , 16° , 16° , 20° , 25° , 0 (inch)] ? Draw tool geometry in ASA system and ORS system?	10	2	2	2. 1. 1
C)	Differentiate between free cutting and non-free cutting (orthogonal cutting operation)?	5	2	2	2. 2. 1

END SEMESTER EXAMINATION MAY 2022

Q3. A)	Explain in brief measurement of cutting forces with the help of three basic principles? Explain working of strain gauge type 2-D turning dynamometer in brief?	5	2	1	1. 2. 2
B)	Explain cutting fluid selection criteria in detail based on process performance and effect on the workpiece/machine tool system?	5	2	2	1. 1. 2
C)	Explain the different design requirements of the tool force dynamometer? Give comparison of cooling and lubrication effects for different cutting fluids? Write a short note on lubrication in metal cutting?	10	3	2	2. 1. 2
Q4. A)	Give advantages to thread rolling and ring rolling operation?	5	3	2	1. 2. 2
B)	Explain *Cluster* rolling Mills with the help of a neat schematic sketch along with their specific application?	5	3	1	2. 1. 1
C)	Explain flat rolling process (mechanics) with the help of a neat schematic sketch? Give significance to "Draft"?	10	3	2	1. 2. 2
Q5. A)	i) Sketch and calculate punch and die size, ii) punch length and die block size iii) Suggest material selection criteria for punch, iv) press capacity? For manufacturing of hard steel washer having outer diameter 25mm, inner diameter 15 mm, thickness 2.1 mm. Ultimate shear strength of material is 32 kg/mm^2. Assume efficiency of press 65%, and clearance for hard steel washer material is 4% of stock thickness.	10	4	3	2. 1. 1

Die block thickness (in mm)	Total perimeter of washer to be sheared off (in mm)
15	75 mm
25	75-250 mm
30	For larger perimeter values

'E' Young modulus of elasticity for punch material = 2.1 X 10^3 ton/cm^2.

END SEMESTER EXAMINATION MAY 2022

B)	Explain the following sheet metal shearing operation along with one combined sketch? a) Trimming, b) Notching operations	5	4	1	1.2.1
C)	Give effects of clearance between punch and die on sheet metal shearing operation?	5	3	1	2.1.2
Q6. A)	i) Determine bending force in channel/U bending for the following data: Thickness of blank = 3.2 mm, bending length = 900 mm, die radius = punch radius = 9.5 mm, ultimate tensile strength of material = 400 N/mm^2. ii) Explain upsetting/flat die forging, uniform deformation and pancaking with the help of a neat sketch?	10	3	3	1.2.2
B)	How the continuous chip formation takes place in outer diameter turning of ductile material at high speed and low feed? Explain the relationship between plowing force and size effect? How cutting velocity affects the size of built up edge formation on cutting tool during machining operation?	10	1	2	1.2.1
Q7. A)	With the help of a neat schematic sketch explain die design features for impression die forging?	10	3	2	1.2.2
B)	Draw sketch and explain the rotary swaging/radial forging operation? Write a short note on forging defects?	10	3	1	2.1.1