

(3 Hours)

Max. Marks: 80

Note:

1. Question No.1 is compulsory.
2. Solve any 3 from remaining 5 questions.
3. Total No. of questions to be attempted are Four
4. Assume suitable data, if necessary.

Q1

- | | | |
|----|---|------------|
| a) | Explain the concept of homogenous coordinate system and its significance. | Marks
5 |
| b) | Explain the difference in adaptive and feedback control & in what circumstances the Adaptive Control is preferred? | 5 |
| c) | What are the major steps to solve the problem using FEM? Whether it gives exact answers? Why it has become popular? | 5 |
| d) | Explain Drive-part-check (DPC) surface syntax in APT programming by considering a suitable example. | 5 |

Q2

- a) Write a Manual part program for finishing the following forged component as shown in Fig. 1. Illustrate the meaning of each code used in the program and the tool movement by showing the tool path. 08
- Take spindle speed as 1000 rpm and feed rate 0.5 mm/rev. Use the diametral format for programming.

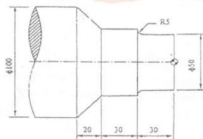


Fig. 1

- | | | |
|----|---|----|
| c) | Write the program for the above component (fig.1) assuming the raw billet size of dia. 100 mm and length 150 mm, using the canned cycle for rough turning followed by finished turning, keeping the finishing allowance as 0.5 mm and 0.3 mm along Z and X axis respectively. | 06 |
| d) | Find the Transformation that rotates the object points through 30 degrees about point (1, 2). To what does the point (2, 3) maps? | 06 |

TURN OVER

Q3

- a) List the different types of hidden line/surface (HLR/HSR) removal algorithms 10
explain any one in detail.
- b) Explain Selective Laser Sintering (SLS) and how is it different from 3D printing? 10

Q4

- a) Explain the elements of computer integrated manufacturing and their functioning. 08
- b) What do you mean by parametric & nonparametric expression of curves? What are the advantages of parametric curves? Express the equation of Line & circle in the parametric form. 08
- c) What are the different types of errors which may get introduced while converting the CAD solid model into RPT compatible format? 04

Q5

- a) Find the Transformation matrix which aligns a given vector $V = aI + bJ + cK$ in three dimensional space with positive Z axis. 10
- b) Explain- 10
i) P & H refinement methods of CAE
ii) Compare Bezier and B spline blending functions.

Q6 Explain any four of the following (any four)

- a) Automated guided Vehicle
- b) Rapid Tooling
- c) AI in Design
- d) Applications of RPT
- e) Role of CAD/CAM in CIM.

5
5
5
5
5



QP Code : 5854

(REVISED COURSE)

Max.Marks: 80
Duration : 3 hrs.

NB: 1. Question No. 1 is compulsory.

2. Solve any three questions from remaining questions.
3. Assume suitable data with proper justification if required.
4. Use of standard design data book like PSG, Mahadevan is permitted.

Q.1. Answer any four of the following

(20)

- (a) Explain various types of gear tooth failures.
- (b) Explain static and dynamic seals with examples.
- (c) Define pressure angle and explain its significance in the design of cam.
- (d) Discuss advantages and disadvantages of rolling contact bearings over sliding contact bearings.
- (e) What are design requirements of friction clutches and how are they selected?

Q.2. A pair of helical gears is used to transmit power from electric motor rated at 25 kW, 960 rpm. The motor is coupled to the pinion shaft and the output shaft is required to rotate at 250 rpm and it is parallel to pinion shaft. The helix angle is 17 deg. and the gears are 20° pressure angle stub teeth.

(20)

- (i) Selecting suitable material, determine number of teeth, module, width etc.
- (ii) Check the gear for dynamic load using Buckingham's analysis for average gear.
- (iii) Design the pinion and gear blanks and draw sketches with dimensions

Q.3. (a) A worm reduction unit is required to transmit 15 kW power from an electric motor operating at 1440 rpm, the output speed is 80 rpm and the load is with mild shock, duty normal. Selecting suitable material and stresses, design worm and worm wheel for strength and wear. Do not check for heat dissipation capacity.

(10)

[TURN OVER]



- (b) A deep groove ball bearing having SKF No. 6314 is subjected to load cycles as below which is repeated. (10)

Phase	Radial Load (KN)	N (rpm)	%age
I	3.5	300	15%
II	4.5	380	40%
III	7.5	270	45%

Under each phase the loads average with high shock. Inner race under rotation and operating temperature 135°C . Determine expected life of the bearing in hours with probability of survival being 93%.

Q.4

- (a) The radial load on a 180° hydrodynamically lubricated journal bearing is 12 KN. Journal speed is 960 rpm. Assuming suitable fit, design the bearing for average clearance. Considering heat generated is dissipated from the bearing surface area, which is 25L.D. . The bearing, which is placed in an oil bath, is cooled by moving air. The pressure is limited to 1.5 N/mm^2 . Find oil flow rate, coefficient of friction, power loss and temperature rise. (10)
- (b) Design cross section of the flat belt drive to run the compressor having reduction ratio 3.15. Input speed is 960 rpm and power to be transmitted 15 kW. Compressor runs to 10-12 hours per day. Expected life of the belt is $1\frac{1}{2}$ years. (10)

Q.5 A rotary plate cam and central translatory follower has following motion: (20)

Outward motion of 25 mm in 100 degrees of cam rotation with parabolic motion, return to normal position with SHM in 90° rotation of cam and dwell for the remaining period. The mass of the follower is 1.5 kg and the cam shaft rotates at 600 rpm. Maximum pressure angle is 25° during forward stroke. The external force is 300 N during forward stroke and 50N during return stroke.

- Design the cam, the roller follower along with its pin and spring.
- Calculate the maximum cam shaft torque.

Q.6. (a) 7.5 kW power is transmitted by a multiplate clutch at 960 rpm. The plates run in oil and coefficient of friction is 0.07. Axial intensity of pressure is not to exceed 0.15 N/mm^2 . Due to space limitations, external radius is restricted to 125 mm. (12)

- i) Determine number of plates and inner radius.
- ii) Design input shaft and output splined shaft.
- iii) If the clutches use 6 springs, decide dimensional details of the spring.

(b) A chain drive is required to transmit 7.5 kW power from a shaft rotating at 960 rpm with a reduction ratio of 3.5 approximately. The drive operates for 14-16 hours per day with mild shock and is provided with drop lubrication system. Determine actual factor of safety for designed chain. (08)

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04.12.15

QP Code : 5933

(3 Hours)

[Total marks : 80]

Note: 1) Question no. 1 is compulsory.

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

3) Clearly mention the assumptions made if any.

Q.1 Solve any four

- Differentiate between reciprocating compressors and rotary compressors
- Advantages of multistaging of reciprocating compressors
- Define following terms in centrifugal pump
 - Suction head
 - Delivery head
 - Static head
 - Manometric head
- A single-acting reciprocating pump, running at 50 rpm, delivers $0.01 \text{ m}^3/\text{s}$ of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine: i) The theoretical discharge of the pump, ii) Co-efficient of discharge and iii) Slip and the percentage slip of the pump.
- Discuss the performance characteristics of reciprocating pumps
- What are the applications of compressed air in industry?

Q.2 a) What are the axial thrust in centrifugal pumps ? Discuss the methods of balancing the axial thrust. 8

b) In a trial on a two-stage, single acting, reciprocating air compressor, following data were recorded.

- Free air delivery per minute = 6 m^3
- Free air conditions = 1 bar, 27°C
- Delivery pressure = 30 bar
- Compressor speed = 300 rpm
- Intermediate pressure = 6 bar
- Temperature at the inlet of HP cylinder = 27°C
- Law of compression = $pV^{1.3}$
- Mechanical efficiency = 85 %
- Stroke to bore ratio for LP cylinder = 1.2

Calculate a) Cylinder diameters b) Power input, neglecting clearance volume

12

[TURN OVER]

- Q.3 a) An axial -flow compressor has a constant axial velocity of 150 m/s and 50% reaction. The mean diameter of the blade ring is 35 cm and speed is 15,000 rpm. The exit angle of the blade is 27° . Calculate blade angle at inlet and work done per kg of air. 8
- b) Explain construction and working of centrifugal pump with neat sketch 6
- c) A single-stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75%. Find the number of stages and diameter of each impeller of a similar multistage pump to lift 5 m^3 of water per second to a height of 200 m when rotating at 1500 rpm. 6
- Q.4 a) Explain construction and working of multi-stage, reciprocating air compressor with intercooler with help of neat labeled schematic diagram and P-V diagram. 10
- b) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 rpm works against a total head of 40 m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50 mm, determine: i) Vane angle at inlet, ii) Work done by impeller on water per second and iii) Manometric efficiency. 10
- Q.5 a) A centrifugal compressor running at 12000 rpm delivers $600 \text{ m}^3/\text{min}$ of free air. The air is compressed from 1 bar and 27°C to a pressure ratio of 4 with an isentropic efficiency of 85%. The blades are radial at the impeller outlet and flow velocity of 60 m/s may be assumed throughout constant. The outer radius of the impeller is twice the inner one and slip factor is 0.9. Calculate: i) Final temperature of air, ii) Power input to compressor, iii) Impeller diameter at inlet and outlet and iv) Width of impeller at inlet. 10
- b) Write down energy conservation opportunities in pumping system 10
- Q.6 Write short note on following (any four) 20
- Features of gear pump
 - Air vessels
 - Net positive suction head (NPSH)
 - Diffuser system
 - Leak detection in compressed air net work
 - Choking and surging in case of centrifugal compressor

- Instructions –
1. Question no. ONE is compulsory.
 2. Attempt any THREE out of remaining FIVE questions.
 3. Assume suitable data where ever necessary but justify the same.
 4. Use of calculators, random number tables, normal distribution tables is permitted.
 5. Use graph papers where ever necessary.

1. Attempt any Four of the followings:

(20)

- a) Explain the terms – Optimal order quantity, and Lead time.
- b) What is Monte Carlo simulation? What types of problems can be solved by it?
- c) Explain the following terms with suitable examples – infeasible solution and unbounded solution in the context of Linear programming problem.
- d) Write dual of following LPP.

$$\text{Minimize } Z = 20x + 10y$$

$$\text{Subject to } x + 2y \leq 40$$

$$3x + y \geq 30$$

$$4x + 3y = 60$$

$$x, y \geq 0.$$

e) Solve the following games

	B			
	4	1	2	5
A	7	8	5	9
	2	0	4	3

2. a) The owner of bakery product shop has observed the following demand pattern for a particular brand of cakes.

Daily demand	0	10	20	30	40	50
Probability	0.02	0.08	0.15	0.40	0.30	0.05

Every morning he receives fresh cakes and places order for next day. The order quantity for next day is equal to the number of cakes the demanded on previous day. Assuming that he receives 30 cakes on first day and places order for 30 cakes for next day, simulate the system to determine –

- a) Average number of cakes sold per day.
- b) Probability of stock out on any day.
- c) Average number of unsold cakes per day if he does not sell stale cakes.
- d) Average profit per day if he earns profit of Rs.20 per cake and returns unsold cakes next morning with loss of Rs. 10.

(10)

Random no. 3244 8857 9516 8058 6047 9504 4554 3172 8699 3584

b) At a booking window customers arrive at the rate of 10 per minute approximated to Poisson's distribution. If service time is exponentially distributed with a mean of 15 per minute, determine a) Probability that the booking clerk waits for the customer. b) Probability that there are at least 3 customers in the queue. c) Average number of customers in system d) Average time spent in the queue e) Probability that the customer is served within four minutes. (10)

3. a) Solve the following problem using Two Phase method – (10)

$$\begin{aligned} &\text{Maximize} && Z = 15x + 20y \\ &\text{Subject to} && 3x + y \geq 120 \\ &&& 3x + 11y \geq 330 \\ &&& x + y \leq 80 \\ &&& x, y \geq 0. \end{aligned}$$

b) Five salesmen are to be assigned to five territories. Based on the past performance, the following table shows the annual sales (in lakhs) that can be generated by each salesman in each territory. Find the optimum assignment. ** indicates that Salesman 4 does not wish to work in territory 2. (10)

	T1	T2	T3	T4	T5
S1	27	15	11	14	10
S2	32	28	31	15	18
S3	16	19	16	26	30
S4	18	**	22	32	25
S5	21	20	26	16	12

4. a) The following table gives probability distribution of failures observed for a certain type of light bulbs: (10)

Week	1	2	3	4	5
% failed by the end of week	5	10	25	35	25

There are 10,000 bulbs in use and it costs Rs.20 to replace an individual bulb which has burnt out at the end of the week. If all bulbs are replaced simultaneously it would cost Rs.14 per bulb. It is proposed to replace all bulbs at fixed interval of time, irrespective of their status and to continue replacing burnt out bulbs at the end of every week. At what interval should all the bulbs be replaced? What is the average cost of replacement if all the bulbs are replaced as per individual replacement policy? What is the optimal replacement policy?

b) A TV manufacturing company has three production units and 4 main distribution centers. Cost of transporting one unit from each production unit to distribution centre is given in the matrix. The production capabilities of production units A, B, and C are 60, 75, and 105 respectively and the requirements of distribution centres are 50, 65, 75, and 100 respectively. Determine the optimal distribution policy. Use VAM to find initial solution and MODI for finding optimal solution. (10)

	Distribution Centre			
Plants	W	X	Y	Z
A	17	20	14	12
B	15	21	25	14
C	15	14	15	16

5. a) Comfort Travel Agency arranges 1-week tours to Goa and south Konkan region. The agency has to provide 7, 4, 7 and 8 rental cars over the next 4 weeks. The agency subcontracts with a local car dealer to supply rental needs. The dealer charges a rental fee of Rs.220 per car per week, plus a flat fee of Rs.500 for any rental transaction. The agency, however, may elect to keep the rentals for an additional week and simply continue to pay the rent. What is the best way for the agency to handle the rental situation? (10)

b) Solve the following games – (10)

i)

	B		
A	9	-3	2
	-6	7	-1
	-3	3	-4

ii)

	B				
A	1	3	2	7	4
	3	4	1	5	6
	6	5	7	6	5
	2	0	6	3	1

6. a) A tailor working on contract has to make 2 clothing items A & B. He can make five of each item in an hour and wishes to produce at least 25 items in a day. He can get at the most 16 m² of material needed to produce the items. It takes 1 hour to process 2 m² of A & 1 hour to process 4m² of B. He gets 1 unit of profit after spending 1 hour on item A & five units of profit after spending 1 hour on item B. He can't spend more than five hours on item A. How many hours should he spend making each item to maximize profit? (12)

b) A bush manufacturing company has a contract to supply 5000 bushes to an automobile factory per day. The company has capacity to manufacture 8000 bushes per day and holding cost of 1000 bushes is 8 paisa per day. Set up cost is Rs.20. No shortages are allowed. What would be his frequency of production run? Sketch the inventory. (08)

#####

- N. B. :
- Question No 1 is compulsory.
 - Answer any four out of remaining six questions.
 - Assumptions made should be clearly stated .
 - Assume suitable data wherever required, but justify the same.

- Q-1 Write short notes on any four of the following : [20]
- (a) Load management of power plant.
 - (b) Benefits of cogeneration
 - (c) Mechanical dust collectors
 - (d) Surge tank
 - (e) Cooling system for diesel power plant.
 - (f) Water hammer and its remedial measures.
- Q-2 a) (a) Prove that the condition for economic loading of different units for a power plant site is $dL_1/dL_2 = dL_2/dL_3 = \dots = dL_n/dL_m$ [10]
- A 300 MW thermal power plant is to supply power to a system having maximum and minimum demand of 240 MW and 180 MW respectively in a year. Assuming the load duration curve to be a straight line estimate the Load Factor and Capacity Factor of the plant. [10]
- Q-3 a) Explain with a neat sketch the operation of Pressurised Water Reactor. [10]
- b) Calculate the cost of generation per kWh for a power station having the following data: [10]
- i) Installed capacity of the plant = 210 MW
 - ii) Capital Cost = Rs18000/kW
 - iii) Rate of interest and depreciation = 12%.
 - iv) Annual Load Factor = 60%
 - v) Annual Capacity Factor = 54 %
 - vi) Annual Running Charges = Rs 200 x 10⁶
 - vii) Energy Consumed by power plant auxiliaries = 6%. Calculate the cost of power generation per kWh and the reserve capacity.
- Q-4 a) In a closed cycle gas turbine there is a two stage compressor and two stage turbine. All the components are mounted on the same shaft. The pressure and temperature at the inlet of the first stage compressor are 1.5 bar and 20° C. The maximum cycle temperature and pressure are limited to 750° C and 6 bar. A perfect intercooler is used between the two stage compressor and a reheater is used between the turbines. Gases are reheated in the reheater to 750° C before entering into the LP turbine. Assuming the compressor and turbine efficiencies as 82 % calculate (i) The overall efficiency of the cycle and (ii) The mass of the fluid circulated if the power developed by the plant is 350 kW. [10]

[TURN OVER]

- b) The runoff data of a river at a particular site is tabulated below :

[10]

Month	Mean Discharge (Millions of m ³)	Month	Mean Discharge (Millions of m ³)
January	1500	July	3000
February	1200	August	3600
March	900	September	3000
April	600	October	2400
May	300	November	2100
June	2100	December	1800

(i) Draw the hydrograph and find the mean flow.

(ii) Draw the flow duration curve

(iii) Find the power developed if the head available is 90 m and the overall efficiency of generation is 86%. Assume each month of 30 days.

- Q-5 a) What are the performance characteristics of a coal based thermal power plant. Discuss in brief the factors to be considered for selection of site for locating the plant. [10]
- b) A six cylinder four stroke SI engine having a piston displacement of 700 cm³ per cylinder developed 78 kW at 3200 RPM and consumed 27 kg of petrol per hour. The calorific value of petrol is 44 MJ/kg. Estimate (i) Volumetric efficiency of the engine if the air fuel ratio is 12 on mass basis and intake air is at 0.9 bar and 32° C. (ii) The Brake Thermal Efficiency and (iii) Brake torque. [10]
- Q-6 a) What are advantages of Fluidised Bed Combustion. Explain with a neat sketch the operation of Circulating Fluidised Bed Boiler. [10]
- b) Discuss the effect of reheating and regeneration on the performance of Steam Power plant. [10]
- Q-7 a) List the advantages of a diesel power plant [4]
- b) Discuss in brief the disposal of radioactive waste. [6]
- c) Explain with a neat sketch any one type of Flue Gas Desulphurisation plant. [10]

(3 Hours)

[Total Marks : 80

- N.B. : (1) Question No. 1 is compulsory
(2) Solve any three out of remaining five questions
(3) Figures to the right of the question indicate full marks.
(4) Assume the suitable data wherever necessary.

1. Answer any four

20

- What are the different types of production?
- Discuss the prerequisites of PPC.
- Mention the reasons for storing the inventory.
- What problems are faced in case of lack of product planning?
- What are the assumptions of job sequencing

2. (a) What are the functions of PPC.

10

(b) What is Work Order? How is it prepared in different manufacturing units.

10

3. (a) A materials manager adopts the policy to place an order for a minimum quantity of 500 of a particular item in order to avail discount of 10%. It was found from the company records that for last year 8 orders were placed of size 200 nos. ordering cost is Rs. 500 per order Inventory carrying cost charges at 40%. cost per unit = 400 Rs.

10

- Is the decision of manager Justified
- What is the effect of this decision on company.

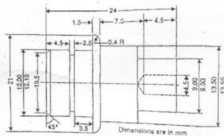
(b) Write short notes on any two :-

10

- Two Bin system
- MRPI & MRP - II
- Just in Time manufacturing system.

4. (a) Prepare the process sheet for the given component.

10



[TURN OVER]

- (b) Demand (In thousands) for bearings of a company is given below. Forecast for the year 2009 was 75 Units. 10

Year	2009	2010	2011	2012	2013	2014	2015
Demand	77	88	94	85	91	98	90

- (i) Estimate the sales forecast for 2016 with least square method.
 (ii) Obtain the forecast of demand for the year 2016 by exponential smoothing method with $\alpha = 0.5$ and compare with earlier forecast.

5. (a) Solve the following LPP 10

Maximize $Z = 3X_1 + 2X_2 + X_3$
 Subject to

$$\begin{aligned} X_1 + 2X_2 + X_3 &\leq 430 \\ 3X_1 + 2X_2 &\leq 460 \\ X_1 + 4X_2 &\leq 420 \\ X_1 + X_2 + X_3 &\geq 0 \end{aligned}$$

- (b) What are the principle functions of Dispatching? What are the documents generally prepared while performing dispatching function? 10

- 6 (a) There Are five jobs, each of which is to be processed through three machines A, B, C in the order ABC Processing time in hours are 10

JOBS	A	B	C
1	3	4	7
2	8	5	9
3	7	1	5
4	5	2	6
5	4	3	10

Determine the optimum sequence for the five jobs and the minimum elapsed time. Also calculate the waiting time for three machines.

- (b) For the activities given below draw the network diagram. Time estimates (in days) for each activity are also given. Determine 10
- Draw the network diagram and find the project duration.
 - The probability of completing the project in 32 days.

[TURN OVER]

QP Code : 5979

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Activity	Optimistic Time	Most Likely Time	Pessimistic Time
1-2	6	9	18
1-3	5	8	17
2-4	4	7	22
3-4	4	7	16
4-5	4	10	22
2-5	4	7	10
3-5	2	5	8

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