

Note: Steam tables and Refrigeration and Air-conditioning tables approved by the Chairman, Autonomous Examinations is permitted.

**PART-A****(5 x 2 = 10 Marks)**

Note: (i) Answer any FIVE questions out of which question No.8 is compulsory.

(ii) All questions carry equal marks.

- 1 What is meant by excess air?
- 2 State the Fourier's law.
- 3 Mention any four components of I.C.engine.
- 4 Define brake power.
- 5 Classify steam turbine.
- 6 What is wet bulb temperature?
- 7 State the merits of hydel power plant.
- 8 What do you meant by radio activity?

**PART-B****(5 x 3 = 15 Marks)**

Note: (i) Answer any FIVE questions out of which question No. 16 is compulsory.

(ii) All questions carry equal marks.

- 9 What are the merits and demerits of gaseous fuels?
- 10 Compare air cooling and water cooling systems.
- 11 List the various efficiencies of I.C.engine.
- 12 Draw the P-V diagram and T-S diagram of Rankine cycle.
- 13 Compare jet and surface condenser.
- 14 What are the desirable properties of refrigerant?
- 15 How does industrial air conditioning is different from comfort air conditioning?
- 16 Explain the concept of nuclear fission.

**PART-C****(5 x 10 = 50 Marks)**

Note: (i) Answer all the questions choosing either sub-division (A) or sub-division (B) of each question. (ii) All questions carry equal marks.

- 17 A Sketch and explain the use of orsat apparatus used in determining the percentage of exhaust gases. 10  
(OR)  
B Derive an expression for the quantity of heat flow through a cylinder. 10
- 18 A Explain the valve timing diagram for a four-stroke petrol engine. 10  
(OR)  
B An engine uses 6.5 kg of oil per hour of calorific value 30,000 kJ/kg. If the B.P of the engine is 22 kW and mechanical efficiency is 85%, Calculate i) Indicated thermal efficiency ii) Brake thermal efficiency and iii) Specific fuel consumption in kg/B.P/h. 10
- 19 A Explain with neat sketch of cyclone separator and wet scrubber. 10  
(OR)  
B In a surface condenser, the vacuum maintained is 700 mm of Hg. The barometer reads 754 mm. If the temperature of condensate is 18°C, Determine i) mass of air per kg of steam ii) Vacuum efficiency. 10
- 20 A Derive an expression for the C.O.P. of Bell-Coleman cycle. 10  
(OR)  
B A Sleeve psychrometer reads as 40°C dry bulb temperature and 28°C wet bulb temperature. Assuming the barometric pressure as 1.013 bar, determine i) Humidity ratio ii) Relative humidity iii) Dew point temperature and iv) Enthalpy of mixture per kg of dry air. 10
- 21 A Explain the layout of diesel power plant with a neat sketch. 10  
(OR)  
B List out merits and demerits of nuclear power plant. And also mention the nuclear power plant in India. 10

Code: 150-2306

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THIAGARAJAR POLYTECHNIC COLLEGE, SALEM

(Autonomous)

Reg. No.

October/November 2019 Examinations  
DIPLOMA IN MECHANICAL ENGINEERING  
Process Planning and Cost Estimation

Year/Sem: III/V (ODD-III)

Max. Marks : 75

Time : 3 hr.

**PART-A**

(5 x 2 = 10 Marks)

Note: (i) Answer any FIVE questions out of which question No.8 is compulsory.

(ii) All questions carry equal marks.

- 1 List out any two activities of process planning.
- 2 Define value analysis.
- 3 Mention two characteristics of special purpose machines.
- 4 State the purpose of flow diagram.
- 5 What is Ergonomics?
- 6 What is prime cost?
- 7 List down the cutting variables.
- 8 What is indirect material cost?

**PART-B**

(5 x 3 = 15 Marks)

Note: (i) Answer any FIVE questions out of which question No. 16 is compulsory.

(ii) All questions carry equal marks.

- 9 Enumerate three advantages of computer aided process planning.
- 10 Mention the types of operations.
- 11 List out any three examples of fixed cost.
- 12 Enumerate three techniques used to reduce work content.
- 13 State the various techniques of work measurement.
- 14 Enlist any three expenditures included in the administrative over head.
- 15 Enlist the estimation of total time for producing a component.
- 16 Find the time required to face an end of a component of 40mm dia. Take job rotation as 100 rpm and cross feed as 0.3 mm/rev.

**PART-C**

(5 x 10 = 50 Marks)

Note: (i) Answer all the questions choosing either sub-division (A) or sub-division (B) of each question. (ii) All questions carry equal marks.

- 17 A Briefly explain the factors that are considered for taking make or buy decision. 10  
(OR)  
B Briefly explain the various steps involved in doing value analysis. 10
- 18 A Explain with an example how machinery requirement is determined. 10  
(OR)  
B Prepare operation sheet for the manufacturer of hexagonal bolt in standard size. List out the sequence of operations performed. 10
- 19 A Write down the basic procedure followed for conducting method study. Briefly explain each step. 10  
(OR)  
B Explain briefly the various steps involved in the conduct of stop watch time study. 10
- 20 A Describe with a block diagram, how the selling price of a product is arrived at. 10  
(OR)  
B The monthly requirement of a product is 2000 components. The cost of each component is Rs.8 and the cost of exact set up is Rs.50 per lot. If the carrying charges is 15%. Find the economic lot size. 10
- 21 A Estimate the time required for turning a steel component from 52 mm dia to 42 mm dia. Length of the job is 287.5 mm. The approach and over travel are each assumed to be 6.25 mm. Cutting speed is 45m/min. Depth of cut is 3mm. Feed is 0.4mm/rev. 10  
(OR)  
B A 64 mm dia plain milling cutter with 8 teeth is used to face mill an aluminum block of 200 m long and 40mm wide. The spindle speed is 1600 rpm and the feed is 0.12 mm per tooth per rev. Find the cutting time. 10

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Note: (i) Answer all the questions, choosing either (a) or (b) of each question.

(ii) All questions carry equal mark marks.

(iii) P.S.G. design data book/ Any other design data book approved by the Chairman, Autonomous Examinations are permitted.

I	A i.	Why are metals in their pure form unsuitable for industrial use?	5
	ii.	Design a sleeve and cotter joint to resist a tensile load of 100 kN. All parts of the material are made of the same material with the following allowable stresses. Tensile stress = 65 N/mm <sup>2</sup> , shear stress = 60 N/mm <sup>2</sup> and crushing stress 130 N/mm <sup>2</sup> .	10
(OR)			
B	i.	Two shafts are connected by means of coupling to transmit 4 kW at 1200 rpm. The flanges of coupling are fastened by means of 3 bolts at a radius of 25 mm. Permissible shear stress in the bolt is 30 N/mm <sup>2</sup> . Find the diameter of the bolt.	5
	ii.	The head of a steam engine cylinder 500 mm diameter is subjected to a pressure of 1 N/mm <sup>2</sup> . The head is held in a position by 16 numbers of M30 bolts. Determine the stress induced in bolt if the joint is steam tight. Assume K=0.5	10
II	A	Design a shaft to transmit power from an electric motor to a lathe headstock through a pulley by means of a belt drive. The pulley weighs 300 N and is located at 200 mm from the centre of the bearing. Diameter of the pulley is 200 mm. Maximum power transmitted is 1500 W at 120 rpm. Angle of lap of the belt is 180° and $\mu=0.3$ . Shock factor in bending and twisting is 1.5 and 2.0 respectively. Allowable shear stress in the shaft material is 35 N/mm <sup>2</sup> .	15
	(OR)		
B	Design a protective type flange coupling to connect two shafts to transmit 7.5 kW at 720 rpm. The permissible shear stress for the shaft, bolts and key materials is 33 N/mm <sup>2</sup> , permissible crushing strength for bolt and key material is 60 N/mm <sup>2</sup> and permissible shear stress for cast iron is 15 N/mm <sup>2</sup> .	15	
III	A i.	What are the factors to be considered for selection of belt drive?	5
	ii.	An open belt drive connects two parallel shafts 1.2 m apart. The driving and driven shafts rotate at 350 rpm and 140 rpm respectively. The driven pulley is 400 mm in diameter. The power to be transmitted is 1.1 kW. Design the drive.	10
(OR)			
B	V belt drive is to transmit 20 kW to a compressor. The motor speed is 150 rpm and the compressor pulley runs at 500 rpm. Determine the size and number of belts required.	15	
IV	A i.	Explain how a ball bearing is designated with an example.	5
	ii.	A 75 mm journal bearing 100 mm long is subjected to 2.5 kN at 600 rpm. If the room temperature is 24° C, find the viscosity of oil to limit the bearing surface temperature at 55°C. Assume D/C=1000.	10
(OR)			
B	In a journal bearing, diameter of shaft is 75 mm, L/D=1, radial clearance is 0.05 mm, minimum film thickness is 0.02 mm, speed of journal 400 rpm, radial load 3.5 KN, specific gravity of oil 0.9 and specific heat of oil 1.75 x 10 <sup>3</sup> J/Kg °C. Calculate viscosity of suitable oil, power lost in friction and resultant temperature rise.	15	
V	A i.	Mention the applications of hand lever and cranked lever.	5
	ii.	A foot lever is 1 m from the centre of the shaft to the point of application of 800 N load. The allowable tensile stress is 75 N/mm <sup>2</sup> and allowable shear stress is 70 N/mm <sup>2</sup> . Determine a) diameter of shaft b) dimensions of boss c) diameter of shaft at the centre of the bearing d) dimensions of key and e) dimensions of rectangular arm of the foot lever at 60 mm from the centre of shaft assuming width of the arm is 3 times the thickness.	10
(OR)			
B	A pair of straight teeth spur gear is to transmit 20 kW when the pinion rotates at 300 rpm. The velocity ratio is 1:3. The allowable static stresses for the pinion and gear materials are 120 N/mm <sup>2</sup> and 100 N/mm <sup>2</sup> respectively. The pinion has 15 teeth and its face width is 14 times the module. Determine the module, face width and pitch circle diameter of both pinion and gear. Also check design.	15	

Note: Refrigeration table with charts in S.I units approved by the Chairman, Autonomous Examinations is permitted.

**PART-A****(5 x 2 = 10 Marks)**

Note: (i) Answer any FIVE questions out of which question No.8 is compulsory.  
(ii) All questions carry equal marks.

- 1 State and define the unit of Refrigeration.
- 2 State the functions of a Condenser and an Evaporator.
- 3 What is the effect of undercooling in Vapour compression refrigeration system?
- 4 List any 4 CFC Free refrigerants and mention their use.
- 5 What are the factors considered while selecting a refrigerant for a given application?
- 6 What is sensible cooling?
- 7 What do you understand by the term cooling load?
- 8 List the factors affecting Human Comfort.

**PART-B****(5 x 3 = 15 Marks)**

Note: (i) Answer any FIVE questions out of which question No. 16 is compulsory.  
(ii) All questions carry equal marks.

- 9 Briefly explain the modes of heat transfer.
- 10 Show the subcooling and superheating processes in the T-S and P-H diagrams of a Vapour compression system.
- 11 What is frost? Explain the effects of frost in Refrigerator.
- 12 Explain freeze drying.
- 13 Draw the skeleton of the Psychometric chart.
- 14 List the thermal properties of an ideal insulator used in comfort air-conditioning.
- 15 Write short notes on refrigeration heat reclaim.
- 16 What is the use of variable primary flow pumping system?

**PART-C****(5 x 10 = 50 Marks)**

Note: (i) Answer all the questions choosing either sub-division (A) or sub-division (B) of each question. (ii) All questions carry equal marks.

- 17 A i. Compare Heat Engine, Refrigerator and a Heat Pump. 5  
ii. Ice is formed from water at 30°C. The temperature of ice formed is – 6°C. The temperature of the brine is –10°C. Find the mass of ice formed per hour if 150 kW is required to drive the unit. Assume that the refrigeration cycle used is perfect reversible Carnot cycle. Take latent enthalpy of ice as 335 kJ/kg and specific heat of ice as 2.1 kJ/kg K. 5
- (OR)**
- B With the help of simple sketches, explain the working of natural and forced draft cooling towers. 10
- 18 A A vapour compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no undercooling of the liquid before the expansion valve. Determine i) C.O.P of the cycle; and ii) Capacity of the refrigerator if the fluid flow is at the rate of 5 kg/min. Use the following data provided. 10

Pressure (Bar)	Sat. Temp. (K)	Enthalpy (kJ/kg)		Entropy (kJ/kg)	
		Liquid	Vapour	Liquid	Vapour
60	295	151.96	293.29	0.554	1.0332
25	261	56.32	322.58	0.226	1.2464

**(OR)**

- B i. Explain the working of Electrolux Refrigerator. 5  
ii. Differentiate Absorption system and Vapor compression Refrigeration system. 5

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- 19 A With a neat sketch explain the construction and working of a Solenoid valve used in the refrigerator. 10
- (OR)**
- B i. List and explain the important desirable properties of refrigerants. 5  
ii. Explain the working of cold storage plants. 5
- 20 A Atmospheric air with dry bulb temperature of  $28^{\circ}\text{C}$  and a wet bulb temperature of  $17^{\circ}\text{C}$  is cooled to  $15^{\circ}\text{C}$  without changing its moisture content. Show the process in the Psychometric chart. Also find i) Original relative humidity ii) Final relative humidity and iii) Final wet bulb temperature. 10
- (OR)**
- B With a simple sketch explain the working of year round Air-conditioning system. 10
- 21 A i. List the energy conservation opportunities in refrigeration systems. 5  
ii. Explain Thermal energy storage systems. 5
- (OR)**
- B Explain the methods used for determination of duct size. 10
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