

**Note: Approved Steam tables & Refrigeration and Air-conditioning tables may be 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 are the requirements of a good fuel?
- 2 List the modes of heat transfer.
- 3 What are the types of nozzles used in CI engines?
- 4 What is the function of crankshaft ?
- 5 List the effects of pollutants by thermal power plant.
- 6 Define C.O.P. of refrigeration unit.
- 7 What is the function of a control rod in a nuclear reactor?
- 8 Define WBT.

**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 is stoichiometric air?
- 10 Compare two stroke and four stroke engines.
- 11 Write the purpose of conducting morse test.
- 12 Why compounding is necessary in steam turbines?
- 13 List the types of steam power cycles.
- 14 Compare vapour compression and vapour absorption system
- 15 Classify nuclear reactors.
- 16 List the various psychometry processes.

**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 divisions carry equal marks.**

- 17 A A fuel has the following composition by weight : 10  
Carbon-92% ; Hydrogen – 4% ; Oxygen – 1.5% , Sulphur-2%, and ash -0.5%. Find the gravimetric composition of the products of combustion if it is supplied with 50% excess air.
- (OR)**
- B Explain the conduction mode of heat transfer through a plane wall and composite wall with neat sketch. 10
- 18 A Explain the construction and working of battery coil ignition system with neat sketch. 10
- (OR)**
- B During a trial of four stroke single cylinder oil engine the following observations were recorded: 10  
Duration of trial – one hour  
Fuel consumption – 7.05kg  
Calorific value of fuel – 44000kJ/kg  
Net load on brake – 1350 N  
Brake drum diameter – 1600mm  
Mass of cooling water – 495kg  
Temperature raise of cooling water – 38° c  
Temperature of exhaust gas – 300°c  
Air consumption – 311kg,  
Assume room temperature -20°c, Speed =300 rpm  
Specific heat of exhaust gas -1.004 kJ/kg°K  
Sp.heat of water-4.1868 kJ/kg°K  
Draw up a heat balance sheet of trial.

- 19 A Explain the working of a steam power plant with the layout. 10  
(OR)  
B A surface condenser receives 40kg/min of steam at 35°C and 0.85 dry. The pressure is constant throughout the condenser. Determine the mass of cooling water required in kg/min, if the cooling water temperature raise is limited to 11°C, and the condensate leaves at 30°C. 10
- 20 A Explain with a neat sketch the working of vapour absorption method of refrigeration system. 10  
(OR)  
B Explain with a neat sketch the working of Central air conditioning system. 10
- 21 A Explain pressurized water reactor with neat sketch. 10  
(OR)  
B i) Explain hydel power plant with layout. 5  
ii) Compare nuclear power plant with thermal power plant. 5
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**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 Define Process Planning.
- 2 List the applications of the value analysis.
- 3 What is process selection?
- 4 List the objectives of work study.
- 5 What is rating factor?
- 6 Define teardown time.
- 7 What are the principle elements of metal machining?
- 8 A shaft of 25 mm diameter is turned at a cutting speed of 50 m/min. Find the rpm of the shaft.

**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 principles of line balancing?
- 10 Compare the cost control and cost reduction.
- 11 Explain the process flow choice.
- 12 Explain the techniques used to reduce work content.
- 13 Explain the micro motion study.
- 14 Describe tool change time and sharpening time.
- 15 Write simple steps for calculating machining time for facing.
- 16 Explain the different factors considered for selecting cutting speed.

**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 divisions carry equal marks.**

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|----|---|---|----|
| 17 | A | Explain the concept of process planning.  | 10 |
|    |   | <b>(OR)</b>   |    |
|    | B | Explain the step by step procedure of value analysis.   | 10 |
| 18 | A | Explain the preparation of operation planning sheet for a simple component.   | 10 |
|    |   | <b>(OR)</b>   |    |
|    | B | Explain the factors influencing choice of machinery.  | 10 |
| 19 | A | Explain the basic procedure in making a time study.   | 10 |
|    |   | <b>(OR)</b>   |    |
|    | B | Explain the following   |    |
|    |   | i) Cyclograph   | 5  |
|    |   | ii) Chronocycle graph   | 5  |
| 20 | A | Describe with block diagram how the selling price of a product is arrived at.   | 10 |
|    |   | <b>(OR)</b>   |    |
|    | B | Differentiate with any five aspects between cost estimation and cost accounting.  | 10 |
| 21 | A | Determine the time required to shape a block 400 mm x 150 mm on a shaper working with a cutting speed of 12 m/min and cross feed of 0.85 mm /stroke. Ratio of return stroke to cutting stroke speed is 3:2. Take allowances as 25 mm on each side on length and 5 mm on each side on width.                 | 10 |
|    |   | <b>(OR)</b>   |    |
|    | B | A 30 mm deep slot is to be milled with an 8 cm diameter cutter. The length of the slot is 30 cm. What will be total table travel to complete the cut? If the cutting speed is 20 m/min and feed per tooth is 0.2 mm. Estimate the milling time. The cutter has 24 teeth and one cut is sufficient for slot. | 10 |

THIAGARAJAR POLYTECHNIC COLLEGE, SALEM

(Autonomous)

Reg. No. October/November 2018 Examinations  
DIPLOMA IN MECHANICAL ENGINEERING

Design of Machine Elements

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

Max. Marks : 75

Time : 3 hr.

**Notes:**

i) Answer all the questions, choosing either (A) or (B) of each question

ii) All questions carry equal marks

iii) PSG design data book/any other design data book approved by the Chairman, autonomous examinations are permitted.

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|-------------|---|--|----|
| 1           | A | i) Design factor of safety for ductile and brittle materials   | 5  |
|             |   | ii) In an IC engine, the diameter of the piston is 300 mm and the pressure inside the cylinder is $0.8 \text{ N/mm}^2$ . Find the diameter of the rod if the tensile (or) Compressive stress for rod is $60 \text{ N/mm}^2$ .  | 10 |
| <b>(OR)</b> |   |  |    |
|             | B | Design a sleeve and cotter joint to transmit a tensile load of 80 kN assuming that all the parts are made of the same material. The permissible stresses are $62 \text{ N/mm}^2$ in tension, $125 \text{ N/mm}^2$ in bearing and $78 \text{ N/mm}^2$ in shear.   | 15 |
| II          | A | A solid circular shaft is subjected to a bending moment of $30 \times 10^5 \text{ N-mm}$ and a torque of $100 \times 10^5 \text{ N-mm}$ . The shaft material has an ultimate tensile stress of $70 \text{ N/mm}^2$ and ultimate shear stress of $500 \text{ N/mm}^2$ . The factor of safety is 6. Determine the diameter of the shaft.                     | 15 |
| <b>(OR)</b> |   |  |    |
|             | B | A rigid flange coupling is to be designed to transmit 20kW at 1000 rpm, allowable shear stress for shaft, key and bolt is $40 \text{ N/mm}^2$ , Allowable crushing stress for key and bolt is $80 \text{ N/mm}^2$ and allowable shear stress for flange material is $15 \text{ N/mm}^2$ . Design the coupling.   | 15 |
| III         | A | Design a belt drive to transmit 22.5 kW at 740 rpm to an aluminium rolling machine. The speed ratio is 3. The distance between the pulleys is 3 m, diameter of the rolling machine pulley is 1.2 m, assume no. of plies as 6.  | 15 |
| <b>(OR)</b> |   |  |    |
|             | B | The Following Data Refers to a V Belt Drive. Power to be Transmitted = 75 kW, Speed of driving wheel = 1440 rpm, Speed of driven wheel = 400 rpm, Diameter of driving wheel is 300 mm, Centre distance is 2.5 m, Smaller pulley factor=1.07, Service factor = 1.3, Correction factor for length = 1.07. Design and give the complete details of the drive. | 15 |
| IV          | A | i) Explain how a ball bearing is designated with an example.   | 5  |
|             |   | ii) A Journal bearing of 150 mm diameter is designed to carry a radial load of 9 kN at 1200 rpm. The diametral clearance is 0.15 mm and the power lost in friction is 6 kW. The viscosity of oil at operating temperature is 0.018 kg/m-sec. Find the required length of the journal.  | 10 |
| <b>(OR)</b> |   |  |    |
|             | B | Design a journal bearing for a centrifugal pump to withstand a load of 60 kN. The diameter and the speed of the journal are 150 mm and 960 rpm respectively.   | 15 |

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- V A Design a handlever of rectangular section subjected to a maximum load of 300 N at the end of moment arms of 1.2m. The thickness of the lever is constant and is equal to 0.375 times the width of the lever near the boss. Permissible shear stress for the shaft material is  $42 \text{ N/mm}^2$  and the Permissible bending stress for the lever material is  $80 \text{ N/mm}^2$ . 15

(OR)

- B A gear drive is required to transmit a maximum power of 22 kW. The velocity ratio is 1:2. The pinion rotates at 200 rpm. The approximate centre distance between the shafts may be taken as 600mm. The teeth has  $20^\circ$  stub involute profiles. The material used for the gear is Cast Iron. Determine the module, face width, number of teeth on each gear. Check your design for dynamic and wear loads. 15

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Note: Use of Refrigeration Tables and Psychrometric charts 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 Define Conduction.
- 2 State the effects of under cooling.
- 3 What is the use of accumulator?
- 4 Define refrigerants.
- 5 Define Wet bulb Temperature.
- 6 Define Sensible heat factor.
- 7 What is occupants load?
- 8 What is heat engine?

## 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 A refrigerator works between the temperature limits of 27°C and -3°C and work done on a compressor is  $10 \frac{kg}{sec}$ . Find the COP and refrigerating effect.
- 10 State the effects of varying evaporator pressure.
- 11 Compare the Absorption system with Vapour Compression (Mechanical) system.
- 12 Classify the refrigerants.
- 13 Explain sensible heating process with a neat sketch.
- 14 State any three factors governing optimum effective temperature.
- 15 Classify the duct system.
- 16 Discuss about Heat pump.

## 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 divisions carry equal marks.

- 17 A Explain the working of closed Air refrigeration system with a neat line sketch. 10  
(OR)  
B Explain the working of Natural draught cooling tower with a neat sketch. 10
- 18 A The temperature limits of an ammonia refrigerating system are 25°C and -10°C. If the gas is dry at the end of Compression, Calculate the COP of the cycle assuming no under cooling of the liquid ammonia. 10

## Properties of Ammonia

Temp °C	Enthalpy KJ/kg		Entropy KJ/kg°k	
	Liquid	vapour	Liquid	Vapour
25	298.9	1465.84	1.1242	5.04
-10	135.37	1433.05	0.5443	5.4784

(OR)

- B Explain the working of an Electrolux system with a neat sketch. 10
- 19 A Explain the working of an thermostatic expansion valve with a neat sketch. 10  
(OR)  
B With a neat sketch, explain the working of an ice making plant. 10
- 20 A Explain the process of adiabatic cooling with humidification with a neat sketch. 10  
(OR)  
B Explain the working of window type air conditioner with a neat sketch. 10
- 21 A Explain with chilled water system with a neat sketch. 10  
(OR)  
B Explain the variable refrigerant flow system with a neat sketch. 10