PSC Mechanical Engineering Examination Previous Year Question Paper

Exam Name: ***Mechanical Engineering***

Date of Test : n/a

Question Paper Code: 078/2015

Medium of Questions: English

PART II

Answer ALL questions. Answer shall be limited to one paragraph.

Questions 31 to 38 carry 10 marks each.

31. A leather belt 9 mm × 250 mm is used to drive a cast iron pulley 900 mm in diameter at 336 rpm. If the active arc on the smaller pulley is 120° and the stress in tight side is 2 MPa, find the power capacity of the belt. The density of leather may be taken as 980 kg/m^3 and the coefficient of friction of leather on cast iron is 0.35.

32. A component is subjected to completely reversed stress cycle which varies over a 30 second time period, as follows :

    10 cycles at 500 MPa

    5 cycles at 600 MPa

    3 cycles at 700 MPa

    The corresponding fatigue lives for the above stresses are 10^5, 4×10^4 and 1.5×10^4 cycles respectively. Determine the fatigue life of the component.

33. A Diesel engine has a compression ratio of 14 and cut-off takes place at 6% of the stroke. Find the air standard efficiency.

34. A 400 kg diesel engine mounted on a chassis frame runs at 500 rpm. The static deflection of the weigh is 2.4 mm. The reciprocating parts have a mass of 18 kg. The stroke of the engine is 160 mm. The damping coefficient of the dash pot attached is 2 N/mm/s. Determine the amplitude at steady state and the resonance speed

35. A cantilever of length 'l', moment of inertia 'I' and Young's modulus 'E' carries a concentrated load W at the middle of its length. Calculate the slope of the cantilever at the free end.

36. A person of mass 80 kg and another person of 60 kg stand side by side at the same end of a 130 kg boat, ready to dive each with a velocity of 5 m/s relative to the boat. Determine the velocity of the boat after they have both dived. Assume that the 80 kg person dives first.

37. A boiler produces 2000 kg of dry and saturated steam per hour at 10 bar and feed water is heated by an economizer to a temperature of 110°C. 225 kg coal of a calorific value of 30100 kJ/kg are fired per hour. If 10% of coal remains unburnt find the thermal efficiency of the boiler. Enthalpy of dry saturated steam at 10 bar is 2776.2 k J/ kg.

38. A damped vibrating system consists of a mass of 8 kg which makes 30 oscillations in 18 seconds. After 5 oscillations, the amplitude reduced to 0.25 times the initial value. Determine the spring stiffness, logarithmic decrement, damping coefficient and damping factor.

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24. In arc welding process an increase in the arc length

(a) Increases the voltage, causing fall in the current and thereby decreasing melting rate

(b) Decreasing the V, causing tall in I and thereby decreasing melting rate

(c) Increases the V, causing an increase in I and melting rate

(d) Decreases the V, causing an increase in I and melting rate

25. A domestic refrigerator is loaded with food and the door closed. During a certain period the machine consumes 1 kWhr of energy and the internal energy of the system drops by 5000 kJ. Find the net heat transfer of the system

(a) 8.6 MJ (b) –8.6 MJ

(c) 5 MJ (d) –5 MJ

26. The operation of enlarging a hole is called

(a) drilling (b) reaming

(c) boring (d) counter sinking

27. In a fuel cell electricity is produced by

(a) Combustion of fuel (b) Oxidation of fuel

(c) Thermionic action (d) All of the above

28. In transonic regime Mach number is between

(a) 0.8 – 1.2 (b) 0.8 – 5

(c) 1.2 – 5 (d) 0.2 –1

29. If the arrival takes place every 10 minutes with a service time of 4 minutes per unit, then the mean arrival rate, mean service rate and the probability one would have to wait will be respectively

(a) 1,0.4, 0.25 (b) 0.1, 0.25, 0.1

(c) 0.1, 0.25, 0.4 (d) 1.0, 0.4, 0.25

30. Oil flows through a 200 mm diameter horizontal cast iron pipe, friction factor $f = 0.0225$ at a rate of flow 0.2 m^3/s. What is the length of the pipe if head loss due to friction is 118.16 m of the oil? $g = 9.81 m/s^2$?

(a) 500 m (b) 1000 m

(c) 250 m (d) 200 m

19. The actual demand of the product is 65, the previous year's forecast is 60 and the value of smoothing 0.3, what would be the forecast for the current year using exponential smoothing method of forecasting?

(a) 61.5 (b) 60

(c) 62.5 (d) 62

20. Shrinkage allowance is provided in the pattern to compensate for shrinkage when

(a) The temperature of liquid metal drops from pouring to freezing temperature

(b) The metal changes from liquid to solid state at freezing temperature

(c) The temperature of solid phase drops from freezing to room temperature

(d) The temperature of metal drops from pouring to room temperature

21. Match the following :

	Equipment		Parameter measured
A.	Diffraction grating	1.	Small angular deviations on long flat surfaces
B.	Optical flat	2.	On-line measurement of moving part
C.	Auto collimator	3.	Measurement of gear pitch
D.	Laser scan micrometer	4.	Surface texture using interferometry
		5.	Measurement of very small displacements

(a) A-4, B-5, C-1, D-2 (b) A-5, B-4, C-1, D-2

(c) A-1, B-2, C-4, D-5 (d) A -2, B-4, C-1, D-5

22. Reynolds's number is the ratio of inertia force to

(a) Viscous force (b) Gravity Force

(c) Elastic Force (d) Pressure Force

23. The percentage change in cutting speed required to give 50% reduction in tool life when n = 0.25 is

(a) 50 (b) 53

(c) 18.9 (d) 25.3

12. In machining a job on a shaper ram makes 40 strokes per minute and the length of the stroke is 150 mm. Calculate the cutting speed.

(a) 10 m/min (b) 6 m/min

(c) 3.6 m/min (d) 5.6 m/min

13. Which one of the following is a stress relieving treatment?

(a) Normalizing (b) Annealing

(c) Case hardening (d) Tempering

14. A solid shaft resists a bending moment of 3 kN-m and a twisting moment of 4 kN-m together, then maximum torque that can be applied is

(a) 7 kN-m (b) 3.5 kN-m

(c) 4 kN-m (d) 5 kN-m

15. The thermal gradient in a heat generating cylinder under steady conduction at half the radius location will be

(a) One half of that at surface (b) One fourth of that at surface

(c) Twice that at the surface (d) Four times that at the surface

16. An Operating Characteristics (OC) is a plot between

(a) Consumer's risk and producer's risk

(b) Probability of acceptance and probability of rejection

(c) Percentage of defectives and probability of acceptance

(d) Average outgoing quality and probability of acceptance

17. An external gear with 120 teeth meshes with a pinion of 80 teeth module being 6 mm. What is the center to center distance in mm?

(a) 1200 (b) 480

(c) 800 (d) 600

18. A hydraulic turbine develops 1500 kW under a head of 50 m, If the head is reduced to 25 m the power developed in kW is

(a) 600 kW (b) 800 kW

(c) 750 kW (d) 1200 kW

6. A refrigerator and a heat pump operate between the same temperature limits. The coefficient of performance of the pump is 4, Then COP of the refrigerator will be

(a) 3 (b) 4

(c) 5 (d) 6

7. An adiabatic process is the one in which

(a) No heat gain or loss for the working substance

(b) The temperature of the working substance changes

(c) The change in internal energy equals mechanical work done

(d) All of the above

8. A single stage rocket is launched vertically from rest with its thrust programmed to give the rocket a constant upward acceleration of 5 m/s^2. If the fuel is exhausted 10 seconds after the launch, the maximum altitude reached by the rocket (assuming $g = 9.8$ m/s^2) is

(a) 240 m (b) 250 m

(c) 377.55 m (d) 357.55 m

9. The power transmitted by the belt is maximum when the relation between maximum tension (T) and centrifugal tension (T_c) is

(a) $T = T_c$ (b) $T = 0.5\ T_c$

(c) $T = 2T_c$ (d) $T = 3T_c$

10. Cold working is carried out at

(a) Room temperature (b) Below melting temperature

(c) Below recrystallisation temperature (d) Below 150°C

11. In a binary alloy system of A and B liquid phase of 40% A (60% B) is coexisting with solid phase of 80% A(20%B). For an overall composition of 4.5% the weight fraction of liquid phase (W_L) and solid phase(Ws) of A

(a) 0.875 W_L and 0.125 Ws (b) 0.80 Ws and 0.20 W_L

(c) 0.60 W_L and 0.40 Ws (d) 0.36 Ws and 0.64 W_L

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Maximum : 200 marks

Time : 1½ hours

PART I

Answer ALL questions. Answer in one word or a sentence.

Questions 1 to 30 carry 4 marks each.

1. Which one of the following cast irons consists of carbon in rosette form?
   (a) White cast iron (b) Gray cast iron
   (c) Malleable cast iron (d) Nodular cast iron

2. The specific speed of a centrifugal pump depends on the
   (a) Speed and discharge (b) Discharge and power developed
   (c) Speed and head of water (d) Speed, discharge and head of water

3. The annual load factor and the capacity factor in a power plant is 0.6 and 0.5 respectively. The average energy consumption is 876 MWh. The reserve capacity of the plant is
   (a) 66.66 kW (b) 133.33 kW
   (c) 33.33 kW (d) 166.66 kW

4. Match the following metal forming processes with their associated stresses in the work piece.

Metal forming process	Type of force
(I) Wire drawing	(1) Compressive force
(II) Blanking	(2) Tensile force
(III) Extrusion	(3) Shear force
(IV) Bending	(4) Spring back force

   (a) I – 1, II – 3, III – 4, IV – 2 (b) I – 2, II – 3, III – 1, IV – 4
   (c) I – 2, II – 3, III – 4, IV – 1 (d) I – 3, II – 4, III – 1, IV – 2

5. In a gating system the ratio 1 : 2 : 4 represents
   (a) Sprue base area: runner area: ingate area
   (b) Pouring basin area : runner area: ingate area
   (c) Sprue base area: ingate area: casting area
   (d) Runner area: ingate area: casting area

[P.T.O.]