ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2011
EXAMINATION CATEGORGY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION for Mechanical Engineering

Date   : 30th **October 2011**

Total Marks   : **100**

Examination Time   : **2.5 Hours**

Reading Time   : **10 Minutes**

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READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. *First ten minutes are exclusively for reading the instructions and questions. The candidates are not allowed to write during this period.*

2. *The pages of this question paper are numbered from 1-10 to 10 -10 including the cover pages.   Report to the invigilator if any pages are found missing.*

3. *This paper consists of two sections namely **Section-A** and **Section-B. Section- A (50 marks**) consist of 30 multiple choice questions of **1 mark** each and four questions of **5 marks** each. **Section-B (50 marks)** consists of two case studies and candidates are required to attempt only one.*

4. *Mention clearly the question number at the beginning of each answer. For multiple choice questions write the question number followed by answer of your choice in the answer sheet.*

5. *Answer must be written very clearly and support your answers with neat sketches wherever necessary. Use pencils for sketches.*

6. *Candidates are not allowed to write anything on this question paper*

SECTION-A (50 Marks)

Answer all questions.

I. **Multiple choice questions (30 marks). Each question carries 1 mark. Write the question number followed by answer of your choice on the answer sheet.**

1. An Ideal fluid is defined as the fluid which is:

   a) Compressible

   b) Incompressible

   c) Compressible and non-viscous (inviscid)

   d) has negligible surface tension

2. Atmospheric pressure held in terms of water column is

   a) 7.5 meters

   b) 8.5 meters

   c) 9.81 meters

   d) 10.30 meters

3. For a laminar flow through a circular pipe

   a) the maximum velocity = 1.5 times the average velocity

   b) the maximum velocity = 2.0 times the average velocity

   c) the maximum velocity = 2.5 times the average velocity

   d) none of the above

4. The curve shown in the fig.1 with velocity gradient ($\partial u/\partial y$) along x-axis and viscous shear stress τ along y-axis. The curve A in the figure 1 corresponds to

   a) Ideal fluid

   b) Newtonian fluid

   c) Non-newtonian fluid

   d) Ideal solid

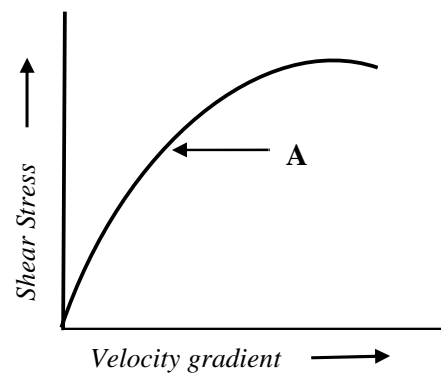*Fig. 1*

5. If the velocity, pressure, density etc., change at a point with respect to time, the flow is called

   a) Uniform
   b) Compressible
   c) Unsteady
   d) Incompressible

6. Supercharging is the process of

   a) Supplying the engine with air at a density greater than the density of the surrounding atmosphere
   b) Providing forced cooling air
   c) Injection of compressed air to remove combustion product fully
   d) Raising exhaust pressure

7. Hydrostatic stress results in the following

   a) Linear strain
   b) Shear strain
   c) Both linear and shear strains
   d) None

8. Pistons of Diesel engines are usually cooled by

   a) Air
   b) Water
   c) Lubricating oil
   d) Fuel oil

9. For minimum work input in a two-stage compression process the intermediate pressure is the

   a) Arithmetic mean of suction and discharge pressures
   b) Logarithmic means of suction and discharge pressures
   c) Geometric mean of suction and discharge pressures
   d) Hyperbolic mean of suction and discharge pressures

10. Which one of the following represents open thermodynamic system?

    a) Manual ice cream freezer

    b) Centrifugal pump

    c) Pressure cooker

    d) Bomb calorimeter

11. Isentropic flow is

    a) Irreversible adiabatic flow

    b) Reversible adiabatic flow

    c) Ideal fluid flow

    d) Frictionless reversible flow

12. The centre of buoyancy is

    a) Centre of gravity of the body

    b) Point of intersection of the buoyant force and the gravitational force

    c) Point of intersection of the buoyant force and the centre line of the body

    d) Centre of the volume of the displaced fluid

13. In air-water vapour mixture, the partial pressure of water vapour corresponds to the saturation temperature called

    a) Dew point temperature

    b) Wet bulb temperature

    c) Dry bulb temperature

    d) Adiabatic saturation temperature

14. An organization process strategy

    a) will have long-run impact on efficiency and production

    b) must meet various constraints, including cost

    c) is concerned with how resources are transformed into goods and services

    d) all the above

15. A product focused process is commonly used to produce

   a) high-volume, high-variety products

   b) low-volume, high-variety products

   c) high-volume, low-variety products

   d) low-variety products at either high- or low-volume

16. Computer-integrated manufacturing (CIM) includes manufacturing systems
   that have

   a) Computer-aided design, a flexible manufacturing system, inventory control,
      Warehousing and shipping integrated

   b) Transaction processing, management information systems, and decision
      support systems integrated

   c) Automated guided vehicles, robots, and process control

   d) Robots, automated guided vehicles, and transfer equipment

17. Which of the following statement is valid for the diagram in figure 2?
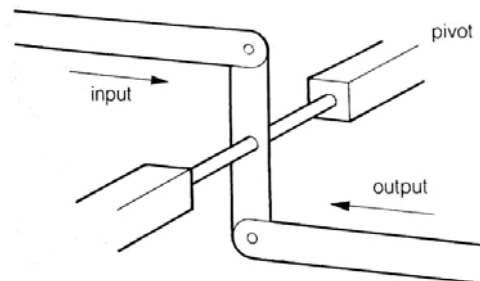
Fig. 2

   a) Input and output forces are equal; direction of motion the same

   b) Output force greater than input force; direction of motion reversed

   c) Input and output forces are equal; direction of motion reversed

   d) Output force smaller than input force; direction of motion the same

18. The air compressor shown in figure 3 is driven via a pulley system from a motor running at 300 r/min. What is the rotation frequency of the compressor shaft?
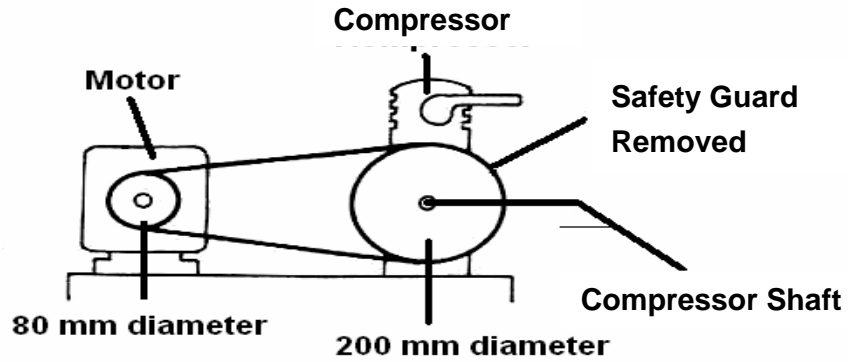

Figure. 3

    a) 201 r/min

    b) 120 r/min

    c) 102 r/min

    d) 750 r/min

19. Turbo prop-engine has the following additional feature over the turbojet :

    a) Propeller

    b) Diffuser

    c) Starting engine

    d) Turbine and combustion chamber

20. Which of the following processes belong to forging operation?

    a) Fullering

    b) Swaging

    c) Welding

    d) End mill

21. During plasma arc welding of aluminium, improved removal of the surface oxide from the base metal is obtained with typical polarity of:

    a) DC Straight

    b) DC reverse

    c) AC potential

    d) Reverse polarity of phase of AC potential

22. The welding process in which bare wire is used as electrode, granular flux is used and the process is characterized by its high speed welding, is known as:

   a) Shielded arc welding

   b) Plasma arc welding

   c) Submerged arc welding

   d) Gas metal arc welding

23. The break-even point can be lowered by:

   a) Increasing the fixed costs

   b) Increasing the variable costs

   c) Decreasing the slope of the income line

   d) Reducing the variable cost

24. When a journal rotates in anticlockwise direction at high speed in a bearing having adequate supply of lubricant, it will be:

   a) Pushed to the left of the bearing centre and is likely to have no metal contact with the bearing.

   b) Resting just below the bearing centre without making metal to metal contact.

   c) Pushed to the right of the bearing centre and make no metal to metal contact.

   d) Running concentric with the bearing centre and make no metal to metal   contact.

25. In a bolt of uniform strength:

   a) Nominal diameter of thread is equal to the diameter of shank of the bolt

   b) Nominal diameter of thread is larger than the diameter of shank of the bolt

   c) Nominal diameter of thread is less than the diameter of shank of the bolt

   d) Core diameter of threads is equal to the diameter of shank of the bolt.

26. An axle is a machine part that is subjected to:

   a) Transverse loads and bending moment

   b) Twisting moment only

   c) Twisting moment an axial load

   d) Bending moment and axial load

27. If there are n_1 discs on the driving shaft and n_2 discs on the driven shaft in a multi-plate clutch, then the number of pairs of contact surfaces is:

   a) $n_1 + n_2$

   b) $n_1 + n_2 - 1$

   c) $n_1 + n_2 - 2$

   d) $n_1 + n_2 + 1$

28. A rope has been designated as 6 x 9. The numbers 6 and 9 respectively stand for:

   a) Rope diameter and the number of wires

   b) Rope diameter and the number of strands

   c) Number of strands and the number of wires

   d) Number of wires and the number of strands

29. If a rod expands freely due to heating, it will develop:

   a) Bending stress

   b) Thermal stress

   c) No stress

   d) Compressive stress

30. Which of the following material is used to make crankshaft in an automobile engine?

   a) Al

   b) Cr

   c) Fe

   d) Cu

II. **Short answer questions (20 marks). Answer all four questions. Each question carries 5 marks. Write the question number followed by answer on the answer sheet.**

1. A hydraulic press has a ram of 15 cm diameter plunger of 2 cm diameter. The stroke of the plunger is 20 cm and weight lifted is 800 kgf. If the distance moved by the weight is 1 meter in 20 minutes, what is the force applied on the plunger? *(W=F/a x A, W=weight lifted, F= force applied on the plunger, a= area of plunger, A= area of ram)*

2. What are the different classifications of fluids and briefly define each classification.

3. What is meant by the term fuel? What are its constituents? Write two advantages of gaseous fuel.

4. Describe the properties of tungsten carbide as a cutting tool material and its applications.

SECTION –B (50 Marks)

Following are the two case studies and candidates are required to attempt only one. This case study carries 50 marks.

1. Bhutan is an agrarian society depending mostly on the agricultural produce. Moreover, due to the geographical location, most of the villages are situated in the most difficult terrain. Although there are ample opportunities for the economic development of the remote villages through the agricultural activities, however, it is constraint due to its inaccessibility to the markets where they could sell their agricultural produce. The Royal Government has prioritized the construction of farm roads to provide access and boast the economic development of the villages. The construction machineries play an important role in the construction of farm roads. Effective management of fleet of construction machineries is crucial for the construction of farm roads.

   As a Manager and Mechanical Engineer for the construction of farm roads, how would you manage and what would be your strategy to deploy the construction machineries efficiently especially to reduce the downtime of the machines.

OR

2. The Government of Bhutan is developing Thimphu Tech Park (TTP) on 18 acres of land at Wangchutaba. The TTP will promote IT / ITes services in the country, including the establishment of a Business Technology Center, an incubation center to promote entrepreneurial activity.

    As an enterprising entrepreneur, what type of IT based industry would you like to set up so that it will not only provide employment opportunities to the Bhutanese youth but also contribute towards economic development of Bhutan.