Manipal Institute of Technology
Department of Mech. & Mfg. Engg.

Mechanical Engineering Science

Test - II

Date: 09/11/2010
Time: 8:00-9:00 am
Max. Marks: 20

Note: i) Answer all the questions,
ii) Draw all the sketches using pencil.

Part – A

1) How does an Economiser help in improving the efficiency of a boiler? 01
2) Briefly explain the Thermodynamic properties to be possessed by an ideal refrigerant. 02
3) Explain the working of multi-stage impulse-reaction turbine with the help of a graph. 03
4) With sketches explain the working of four stroke C. I. engine. 04

Part – B

5) Show the tool-work motions in Facing operation in centre lathe. 01
6) Mention any two differences between AC arc welding and DC arc welding. 01
7) How does the live centre differ from dead centre? 01
8) List two differences between open die forging and impression die forging. 01
9) Sketch and explain the welding process that is used in automobile industry for quick fabrication of car bodies. 03
10) With neat sketches show the nomenclature of single point cutting tool. 03
8. What are the basic differences between brazing and soldering?

9. Draw neat sketches of following machine tools
   a. Lathe
   b. Radial drilling machine
   c. Shaper

10. List and explain the various operations that can be performed on the following machine tools.
    a. Lathe
    b. Drilling Machine
    c. Milling Machine
    d. Grinding Machine
MES SECOND ASSIGNMENT

DATE OF SUBMISSION: 25-4-2011

PART-A

1. Give reasons:
   a. Boiling and freezing temperature of an ideal refrigerant should be low. Why?
   b. Evaporator & condenser pressures should be slightly above the atmospheric pressure.
      Give reason.
   c. Dielectric strength of an ideal refrigerant should be high. Why?

2. Two-stroke engines are compact: why?

3. Why two stroke engines have low efficiency when compared to four-stroke engine?

4. Why spark plug is not present in the diesel engines?

5. Why diesel engines have a higher compression ratio?

6. What is the function of an injector in a Compression ignition engine?

7. What is the difference between a carburetion and injection?

8. Give the significance of the lubrication in I C Engine.

9. Which engine has more power output capacity - petrol engine or diesel engine?

10. Which engine has more mechanical efficiency - 2 - stroke engine or 4 - stroke engine?

11. Which property of the refrigerant has direct influence on the size of the compressor?

PART-B

1. Differentiate between the following (i)Hot and cold chisel (ii)Upsetting and drawing down (iii)Press forging and Die forging
   Compare the grain arrangement of a forged component with that of a casted one.

2. Why are the forged parts subjected to heat treatment?

3. How will weld you two pieces of metals without bringing them to a molten state?

4. Why is an oxidizing flame desirable in welding of copper alloys?

5. Describe the functions and characteristics of electrodes. What functions do coatings have? How are electrodes classified?

6. Why is an oxidizing flame desirable in welding of copper alloys?

7. Describe the functions and characteristics of electrodes. What functions do coatings have? How are electrodes classified?
44) What are the advantages & disadvantages of castings?

45) What is the composition of a moulding sand?

46) Which moulding process is preferable for large and heavy castings?

47) Give reasons for following defects in a casting:
   - Hot tear.
   - Cracks.
   - Mismatch.
   - Sponginess.
   - Cold shut.

48) How does the "arc of contact" and "width of belt" affect the power transmission in an open belt drive?

49) Explain the importance of "Power transmission" by giving two practical examples.
PART - B

36) Explain the different types of pulleys illustrating their application in the technical sector.

37) The blank for the spool shown in the figure below is to be sand cast out of A-319, an aluminium casting alloy. Make a sketch of the pattern for this part, indicate all the different parts of the pattern and include all necessary allowances.

A= dia 80 mm; B= dia 30 mm; C= dia 15 mm; D= 100mm; E= 130mm

38) If you need only one unit of a cast specimen, which process(es) would you use? Justify.

39) Beltdrives Ltd. (http://www.beltdrives.com) is a company that manufactures and supplies belt drives for Harley Davidson’s power transmission unit. Conduct a study and mention why belt is preferred over the conventional chain drives at Harley Davidson. What are the special design changes that are adopted by Beltdrives Ltd. to reduce the losses in power transmission?

40) Why an intermediate mechanism is necessary between the prime mover and the machine?

41) Sketch and explain the transmission system in a machine tool which uses both fast & loose pulley and a cone pulley to drive the machine shaft.

42) In an open belt drive, the net driving tension is equal to the tension on the slack side. Determine the angle of lap on the smaller and larger pulley if \( u = 0.25 \) and the tension on the driving side is 600 N. (Take \( T = 0.10 \) of the driving side tension.)
Department of Mechanical and Manufacturing Engineering

16) High pressure boilers are preferred in steam power plants though they have high risk of explosion. Explain the reasons.

17) What is the need for pressure cockers if one can cook food even in open containers?

18) It is often observed that cooking food stuffs at hill stations takes a longer time than at lower altitudes. Give reasons. Do you think use of a pressure cooker could solve this problem?

19) Where are the superheaters located in Babcock and Wilcox boiler?

20) Under what circumstances are water tube boilers used in preference to the fire tube boilers? Give reasons.

21) Why 2 water gauges and 2 safety valves are fitted on the boiler?

22) What are the valves that are essential for the working of a boiler? Justify their necessity.

23) Is the feed pump, a boiler mounting or accessory? Explain briefly.

24) Ordinary water is not suitable to use in water tube boiler. Why?

25) Where is the separator fitted in a boiler? What is its function?

26) Differentiate between a stop valve and a safety valve used in boilers.

27) State the difference between forced circulation and natural circulation boiler.

28) Among the two, fire tube and water tube boilers which one can generate steam faster? Justify your answer.

29) Why low grades of fuels can be used in water tube boilers and not in the fire tube boilers?

30) Why steam turbine is called as an ideal prime mover?

31) Why is the blade passage in an Impulse turbine of uniform cross section?

32) Why Impulse turbine is suitable only for small power generation plants?

33) Define "Impulse force" in an impulse steam turbine.

34) What is the standard rating of a refrigerator machine?

35) Differentiate between refrigeration, refrigerator & refrigerant.
MECHANICAL ENGINEERING SCIENCE

Assignment – 1

Instructions to students
- Maintain a separate book for answering questions from Part – A and Part – B.
- Answer all the questions.
- Submit the completed assignment to the faculty handling the topic.
- The last date for submission is on or before 04 September 2010.
- Submissions made after the due date will not be evaluated.

PART – A

1) Give 2 examples for internally fired fire tube boiler
2) What is a high pressure boiler?
3) What is the function of fusible plug in fire tube boiler?
4) What is the function of chain grate stoker in water tube boiler?
5) Why sediment deposition is less inside the boiler drum in water tube boiler?
6) Define the term “critical point.”
7) What are the disadvantages of wet steam over superheated steam?
8) Differentiate between “critical point” and “freezing point”.
9) State the uses of superheated steam produce by the boiler.
10) How is steam generated in a large scale? Explain the devices which generate steam according to the flow of water and flue gases using suitable examples.
11) State the quality of steam coming out of household pressure cooker.
12) 3 kg of water is heated from 20°C to dry steam at atmospheric pressure. What is the heat added in the process?
13) Name the type of boilers that are installed near the Mechanical Laboratories of our Institute. Also indicate their specifications.
14) Indicate whether the following boilers are smoke tube or water tube.
   - Simple vertical boiler
   - Boiler in a Railway Engine
   - Boiler in a Road Roller
   - Scotch Boiler
   - Cochren Boiler
   - Lancashire Boiler
   - Yarrow Boiler
   - Babcock and Wilcox Boiler
   - Cornish Boiler
   - Marine Boiler
6A) Steam at higher pressures can be produced in case of Water Tube Boilers. Why?

6B) In a test on a two stroke diesel engine with bore 0.3 m and stroke 45 cm, the following observations were made:

- Duration of test: 1 hour
- Calorific value of fuel: 43.9 MJ/kg
- Total revolutions made: 18,000
- Circumference of the brake drum = 5 m
- Net load on the brake drum = 150 Kg
- Mean effective pressure: 0.3 MPa
- Total fuel used: 7.75 kg

Determine: Indicated Power, Brake Power, Brake thermal efficiency

6C) Give two differences between conventional and climb milling operations

6D) Starting from fundamentals derive the equation for the length of a cross belt drive.
3A) Mention and briefly explain the main parts of a steam turbine.

3B) (i) Make a list of all the boiler Accessories.
(ii) Explain the purpose of Feed check valve and Blow off valve.

3C) What is the function of rake angles in a single point cutting tool?

3D) Gears with the following parameters are available.
   Gear A has a module of 2 and 50 teeth, Gear B has a diameter of 201 mm and 67 teeth, Gear C has a module of 4 and diameter 152 mm, Gear D has a diameter of 50 mm and 25 teeth, Gear E has a module of 3 and 100 teeth, Gear F has a module of 4 and is 350 mm diameter, Gear G has a module of 3 and diameter of 126 mm, Gear H is 60 mm in diameter and 30 teeth, Gear J has 55 teeth and a diameter of 110 mm. Determine an arrangement to obtain the lowest speed possible for the driven shaft, if the power is to be transmitted with four shafts? If the driver gear rotates at 225 rpm, determine the speed of the driven gear.

4A) Define flash and fire point of a lubricant.

4B) Draw a labeled sketch of a Cochran boiler showing the path of the flue gases.

4C) Explain any two functions of coated electrode.

4D) Explain the working of a Radial drilling machine with a labeled sketch.

5A) List four comparisons between a four stroke engine and two stroke engine.

5B) Derive the equation for the determination of the dryness fraction using a combined calorimeter.

5C) Explain the use of a Loose piece patterns with sketch.

5D) Sketch and label the parts of a standard shaper.
Instructions to Candidates:

- Answer ANY FIVE FULL questions.
- Standard values of the Physical constants may be used where required.
- Use of steam tables is permitted.

1A) Find the enthalpy of five kilograms of steam at 12 bar when,
   (i) steam is dry saturated,
   (ii) steam is 42% wet and
   (iii) Superheated to 275°C.

1B) Define the following terms used in refrigeration:
   (i) Refrigeration  (ii) COP  (iii) Refrigerant

1C) Name the mechanism used to reciprocate the ram in shaper.

1D) Explain with sketches, the method of preparing a green sand mould.

2A) Define the following terms:
   (i) Sensible heat  (ii) Latent heat of evaporation

2B) Explain with the neat sketch the working of a 4-stroke Constant volume cycle engine.

2C) Draw a sketch of a board hammer with and label all the parts.

2D) Describe grit, grade and structure of a grinding wheel.
5A) A four stroke petrol engine of 100 mm bore and 150 mm stroke consumes 1 kg of fuel per hour. The mean effective pressure is 7 bar and its indicated thermal efficiency is 30%. The calorific value of the fuel is $40 \times 10^3$ kJ/kg. Find the crankshaft speed.

5B) Draw the sketch of combined calorimeter and indicate all the parts.

5C) Sketch and nomenclature single point cutting tool.

5D) Draw a neat sketch of sensitive drilling machine.

6A) Sketch and explain working of vapour compression refrigeration system.

6B) What is the function of economiser used in steam boilers?

6C) With the help of neat sketch explain the function of fast and loose pulley system.

6D) What are the functions of the following parts in a shaper i) Ram ii) tool head iii) cross rail
1A) List any four differences between 4 stroke petrol and 4 stroke diesel engine.

1B) Draw the P-V graph for pressure and velocity compounded impulse turbine.

1C) Derive the expression for length of the belt for open belt drive.

1D) Explain the following terms with respect to grinding wheel i) Grit ii) Grade

2A) Draw the front and top views of Lancashire boiler and label all the parts on it. Also indicate the path of flue gases in it.

2B) Why do I.C. Engines require piston rings?

2C) Sketch the configuration of the gears that is used for Intersecting axes shafts.

2D) With a neat sketch explain the green sand bench molding technique.

3A) By actual measurement, the enthalpy of three kilo grams of steam at 6 bar is found to be 7500 KJ. What is the quality of steam? If 1500KJ of heat is added to this steam, find what is the superheated temperature and enthalpy of superheat.

3B) List different properties of a good lubricant.

3C) Sketch and explain upsetting process.

3D) What are the differences between horizontal and vertical milling machine?

4A) With sketches explain the working of two stroke Diesel Engine.

4B) List advantages of De-Laval turbine.

4C) What are the differences between soldering and brazing?
PART - B

6 Write short notes on the following
   a) Mould  b) Positive drive  c) Idler gears  d) Sprue.
   e) Direction of rotation for open and cross belt drive
      (between driver and driven)

7 If you are racing from Manipal to Udupi and you have 2 bicycles:

<table>
<thead>
<tr>
<th></th>
<th>Driver sprocket</th>
<th>Driven Sprocket</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of teeth</td>
<td>RPM</td>
</tr>
<tr>
<td>BLUE Bicycle</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>RED Bicycle</td>
<td>100</td>
<td>40</td>
</tr>
</tbody>
</table>

Which bicycle will you choose? Why? (Assume that the diameter of wheels remain same for both the cycles).

8 How many times can you use a freshly prepared green sand mould?
   Give the composition of green sand used for moulding.
   a) Briefly explain any four properties of the moulding sand.

9 Why is shrink allowance positive but shake allowance negative?

10 State any four different methods to transmit power.
   (a) You have four gears with 10, 100, 50, 20 teeth. How will you use them to get a velocity reduction of 25? Draw
PART - A

1. Sketch and label all the parts of a Lancashire boiler indicating the path of flue gases.

2. Define
   i) Latent heat of evaporation   ii) Dry saturated steam

3. Among the two, fire tube and water tube boilers which one can generate steam faster? Justify your answer.

4. Explain the working of a combined calorimeter with a sketch.

5. A combined calorimeter is used to determine the dryness' fraction of steam at a pressure of 9.8 bar. The steam is discharged from the calorimeter at atmospheric pressure and at a temperature of 105°C. During the test 0.2 kg of water is collected into the separating calorimeter and 0.2 kg of steam is discharged from the throttling calorimeter. Find the dryness fraction of steam.
PART - B

6 Define
   i) Slip and creep  ii) Velocity ratio.

7 In what way does a pattern differ from a casting? ✔

8 Write a short note on crowning of pulleys ✔

9 What are the types of defects encountered in a casting if the moisture content in the green sand mold is too high? ✔

10 A pump is driven by an electric motor through an open type flat belt drive. Determine the belt specifications for the following data.

   Motor pulley diameter = 300 mm,
   Pump pulley diameter = 600 mm
   Coefficient of friction for motor pulley = 0.25
   Coefficient of friction for pump pulley = 0.20
   Center distance between the pulleys = 1000 mm
   Rotational speed of the motor = 1440 rpm
   Power transmission = 20 kW;
   Permissible tension/meter width of belt = 10 kN
DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING
MECHANICAL ENGINEERING SCIENCES
1ST SESSIONAL TEST

Note:
1. Draw sketches using pencil only.
2. Answer all the 10 questions.

Time: 1 hour (8 am to 9 am)  
Date: 8 September 2010  
Max marks: 20

PART - A

1. Sketch and label all the parts of Babcock and Wilcox boiler indicating the path of flue gases and water on it.

2. Define
   i) Dryness fraction
   ii) Wet Steam

3. Ordinary water is not suitable to use in water tube boilers. Why?

4. Steam initially at 40°C is heated in a boiler until it is 90% dry. The steam then passes through a pipe where the steam is throttled and becomes superheated steam. Where did the extra heat come from? Justify your answer.

5. Dry saturated steam at 20 bar is generated in a boiler. Dry saturated steam leaves the boiler where it loses heat of 500 KJ/kg. In the superheater, the steam is superheated to 400 deg C. If temperature of feed water is 60 deg C, determine
   a. Total heat supplied to feed water in boiler
   b. Dryness fraction of steam at entry to superheater
   c. Total heat supplied in superheater.

PLEASE TURN OVER
7) Define the following terms
   i. Wet steam
   ii. Latent heat of evaporation

8) List any four main differences between Lancashire boiler and Cochran Boiler.

9) Sketch and label all the parts of Locomotive boiler.

10) A Boiler that operates at 25 bar pressure is supplied with feed water at temperature of 60°C. Dry saturated steam produced by this boiler loses heat of 50 kJ/kg as it travels through the pipe line. However a throttling valve is placed in the pipe line resulting in pressure drop of the steam to 4 bar. This superheated steam is used to run a steam turbine where it further loses heat equal to 1000 kJ/kg at constant pressure of 4 bar.

Determine the following:

i. Total heat supplied to the feed water in the boiler.

ii. Dryness fraction of steam entering the throttling valve.

iii. Temperature of superheated steam after throttling.

iv. Quality of the substance leaving the turbine; find its dryness fraction if wet steam or its temperature if it is unsaturated water.

Assume \( C_{p_{w}} = 4.2 \text{ J/g K} \) and \( C_{p_{s}} = 2.1 \text{ J/g K} \)
1) Justify the statement “For the given distance between the flat pulleys, the crossed connection transmits high power”.

2) What is the function of idler or intermediate gear in a gear train? Show that idler gears don’t influence the velocity ratio in a simple gear train.

3) Which factors make it necessary to go for multi-piece pattern?

4) Sketch and explain the arrangement of gears suitable when the shafts are perpendicular, non-intersecting and need very high velocity ratio.

5) What are negative allowances in a pattern? Give an example.

6) A 5kW motor running at 1750rpm drives a line shaft, at a speed of 800rpm. The motor and the line shaft rotate in counter-clockwise direction. The sum of diameters of the pulleys on the motor and the line shaft is 510mm, The distance between the two shafts is 500mm. Find the length of belt required.

Three machines A, B, and C are driven by the line shaft, their speeds being 300, 500 and 200rpm. The pulleys on the machine are 240, 320 and 400mm in diameter respectively. Find the size of the pulleys to be fitted on the line-shaft.
Instructions to Candidates:
- Answer ALL questions.
- Missing data, if any, may be suitably assumed and justified.
- Neat Sketches to be drawn using pencils only.

Part - A

1. With a neat sketch, explain the working principle of a 4 stroke diesel engine with a P-V diagram. 04

2. List all the thermodynamic, physical and chemical properties of an ideal refrigerant. (At-least 9) 03

3. Sketch and explain the working principle of an impulse turbine with a P-V diagram and force diagram. 03

Part - B

4. Illustrate with a neat sketch, the method of taper turning by off-setting the tailstock in a lathe. 03

5. Sketch and explain the working of a gravity/drop hammer used in forging of metals. 03

6. With a neat sketch, explain the principle of electric arc welding. Also mention the various functions of a coated electrode. 04