

**I B. Tech I Semester Regular Examinations, April/May - 2017**  
**ELEMENTS OF MECHANICAL ENGINEERING**

(Civil Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)  
 2. Answering the question in **Part-A** is Compulsory  
 3. Answer any **FOUR** Questions from **Part-B**

**PART -A**

1. a) List the Primary requirements of a Steam Boiler. (2M)
- b) What are the distinguishing features between a Casting and a Pattern? (2M)
- c) Define (i) Brake Power; (ii) Indicated Thermal Efficiency, of an Internal (2M)  
Combustion Engine.
- d) Define "Ton of Refrigeration (TR)". (2M)
- e) Define: (i) Velocity ratio; (ii) slip of a belt drive. (2M)
- f) What is pressure line and pressure angle of a gear? (2M)
- g) What is the difference between Double helical and Herringbone gears? (2M)

**PART -B**

2. a) Explain the construction and working of Babcock and Wilcox Boiler with a neat sketch. (7M)
- b) Enumerate the factors which should be considered for the selection of a boiler. (7M)
3. a) Briefly Explain the principle of Rolling with a neat sketch. (5M)
- b) Can dissimilar metals be welded by using resistance welding? Explain. (4M)
- c) Distinguish between arc welding and gas welding processes in detail. (5M)
4. a) Enumerate different ways of producing refrigeration. Explain in detail about any two refrigeration systems. (7M)
- b) Derive the equation for work done per kg of air compressed in a single stage single acting reciprocating compressor without cylinder clearance. (7M)
5. a) Compare in detail the Four Stroke and Two Stroke engines. Bring out clearly their relative merits and demerits. (7M)
- b) A four cylinder, four stroke, spark ignition engine has a bore of 80 mm and a stroke of 80 mm. The compression ratio is 8. Calculate the cubic capacity of the engine and the clearance volume of each cylinder. (7M)
6. a) Derive the equation to find out the length of the belt in an Open belt drive. (7M)
- b) The pulleys of two parallel shafts that are 8 m apart are 600 mm and 800 mm in diameters and are connected by a open belt drive. Calculate the length of the belt drive and the angle of contact between the belt and each pulley. (7M)
7. a) What is the difference between a simple gear train and a compound gear train? Explain with the help of neat sketches. (7M)
- b) With neat sketches explain briefly the following with their merits and demerits (7M)
  - i) Spur gear
  - ii) Helical gear
  - iii) Bevel Gear.



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**PART -A**

1. a) What is the function of Boiler Mountings? Can a Boiler work without mountings? (2M)
- b) What do you understand by the following Casting terms: (i) Sprue; (ii) Runner. (2M)
- c) Define (i) Indicated Power; (ii) Specific Fuel Consumption of an Internal (2M)  
Combustion Engine.
- d) Discuss the elements of refrigeration systems. (2M)
- e) State the advantages of Belt drive. (2M)
- f) What do you understand by Pitch circle and pitch point of a gear? (2M)
- g) What do you understand by Reverted Gear train? (2M)

**PART -B**

2. a) Explain the construction and working of Lancashire Boiler with a neat sketch. (6M)
- b) With the help of a neat sketch explain (i) Fusible plug; (ii) Water level Indicator. (8M)
3. a) Explain in detail, how Extrusion is compared with Rolling? (7M)
- b) Name the various patterns that are encountered in Foundry practice. Sketch an example showing the Cope and Drag type Pattern. (7M)
4. a) Discuss in detail the classification of air compressors. (7M)
- b) Explain the working of vapour compression refrigeration system with neat (7M) sketch.
5. a) Discuss in detail the differences between Compression Ignition and Spark (6M) Ignition engines.
- b) A four stroke, compression ignition engine with four cylinders develops an (8M) indicated power of 125 kW and delivers a brake power of 100 kW. Calculate (i) frictional power; (ii) mechanical efficiency of the engine.
6. a) Derive the equation to find out the length of the belt in a Cross belt drive. (7M)
- b) Two pulleys mounted on two parallel shafts that are 2 m apart are connected by a (7M) crossed belt drive. The diameters of the two pulleys are 500 mm and 240 mm. Find the length of the belt and the angle of contact between the belt and each pulley.
7. a) Sketch two teeth of a gear and show the following: (i) Face; (ii) Flank; (iii) (8M) Addendum; (iv) Dedendum; (v) Face width; (vi) Circular Pitch.
- b) A Compound gear train consists of 4 gears, A, B, C, and D having 20, 30, 40, and (6M) 60 teeth respectively. A is key to the driver shaft, and D is keyed to the driver shaft. B and C are compound gears. B meshes with A and C meshes with D.  
 Sketch the arrangement using simple circles. If A rotates at 180 rpm. What is the rpm of D?



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**PART -A**

1. a) Discuss how Boiler Accessories differ from Mountings? (2M)
- b) What do you understand by the following Casting terms: (i) Gate; (ii) Riser. (2M)
- c) Define (i) Friction Power; (ii) Brake Thermal Efficiency of an Internal (2M)  
Combustion Engine.
- d) Define (i) Theoretical COP and (ii) Relative COP of a refrigeration system. (2M)
- e) What do you mean by Initial Tension in a Belt Drive? (2M)
- f) What do you understand by Module and Gear ratio of a gear? (2M)
- g) What do you understand by a Compound Gear train? (2M)

**PART -B**

2. a) Explain the construction and working of Cochran Boiler with a neat sketch. (6M)
- b) With the help of a neat sketch explain (i) Feed Check Valve; (ii) Air Pre-heater. (8M)
3. a) Distinguish between Brazing and soldering from the point of view of the filler (7M)  
metals used, applications and the strength of the joint obtained.
- b) Explain the principle underlying the resistance welding process. Discuss the (7M)  
advantages and disadvantages of Resistance Welding process.



4. a) Describe with a neat sketch, the construction and working of a single stage, single acting reciprocating air compressor. (7M)
- b) Air to be compressed in a single acting reciprocating compressor from 1.013 bar and  $15^{\circ}\text{C}$  to 7 bar, neglecting clearance. Calculate the indicated power required for a free air delivery of  $0.3\text{ m}^3/\text{min}$ , when the compression process is (i) Isentropic; (ii) Polytropic with  $n=1.25$ . (7M)
5. a) Explain with suitable sketches, the working of a Four Stroke Spark Ignition (6M) Engine. (6M)
- b) A two stroke compression ignition engine delivers 5000 kW, while using 1000 kW to overcome friction losses. It consumes 2300 kg of fuel per hour at an air fuel ratio of 20:1. The heating value of fuel is 42000 kJ/kg. Find the (i) Indicated power; (ii) Brake power; (iii) Indicated thermal efficiency; (iv) Brake thermal efficiency. (8M)
6. a) Derive the relation for the ratio of belt tensions in a flat belt drive. (7M)
- b) Show that the centrifugal tension is independent of the tight and slack side tensions and depends only on the velocity of the belt over the pulley. (7M)
7. a) What are the main tooth profiles of gear teeth which fulfill the law of gearing? Compare them. (7M)
- b) State the advantage of compound gear train over a simple gear train. (7M)



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**PART -A**

1. a) Explain the working principle of a Steam Turbine. (2M)
- b) What do you understand by the following Casting terms: (i) Cope; (ii) Drag. (2M)
- c) Define (i) Compression ratio; (ii) Mechanical Efficiency of an Internal (2M)  
Combustion Engine.
- d) What are the applications of compressed air? (2M)
- e) What is the difference between Open belt drive and a Crossed belt drive? (2M)
- f) Explain Addendum and Dedendum of a gear. What is clearance? (2M)
- g) What do you understand by a Simple Gear train? (2M)

**PART -B**

2. a) Explain the construction and working of Cornish Boiler with a neat sketch. (7M)
- b) With the help of a neat sketch explain (i) Economiser; (ii) Blow-off Cock. (7M)
3. a) How is an arc obtained in arc welding? Briefly explain the process of carbon arc- (7M)  
welding.
- b) In detail, discuss the classification of Lathes. Give their applications. (7M)
4. a) Discuss the differences between Reciprocating and Rotary air compressors. (6M)
- b) A single acting, single stage reciprocating air compressor takes  $1 \text{ m}^3$  of air per (8M)  
minute at 1.013 bar, 288 K and delivers at 7 bar. Assuming the law of  
compression  $p v^{1.35} = \text{constant}$ , and neglecting clearance, calculate the Indicated  
power required. If the compressor is running at 300 rpm, find the diameter and  
stroke of the compressor taking  $L/D=1.5$ .



5. a) Explain with suitable sketches, the working of a Two Stroke Spark Ignition (7M) Engine.
- b) A diesel engine develops 5 kW. It's indicated thermal efficiency is 30% and (7M) mechanical efficiency is 57%. Estimate (i) the fuel consumption of the engine in kg/hr; (ii) Indicated specific fuel consumption; (iii) Brake specific fuel consumption.
6. a) Derive the condition for maximum power transmission by a belt drive considering (7M) the effect of centrifugal tension.
- b) The smaller pulley of a flat belt drive has a radius of 220 mm and rotates at 480 (7M) rpm. The angle of lap is  $155^\circ$ . The initial tension in the belt is 1.8 kN and the coefficient of friction between the belt and the pulley is 0.3. Determine the power transmitted by the belt.
7. a) State and derive the law of gearing. (7M)
- b) A compound gear train consists of four gears. The number of teeth on gears A, B, (7M) C and D are 54, 75, 36 and 81 respectively. Gears B and C constitute a Compound gear. Determine the torque on the output shaft if the gear A transmits 9 kW at 300 rpm.

