BE (MET) Part II 3rd Semester Final Examination 2011
General Mechanical Engineering (ME 302)

Time 3 hrs **Full Marks 70**

First Half
Answer all questions

1. (a) Consider the polytropic process, $pV^n = C$. What are the values of 'n' for isobaric, isochoric, isothermal and isentropic processes? For pdV-work, derive the expressions for W_{1-2} and Q_{1-2} for the above processes and the polytropic process between initial state 1 and final state 2.
   (b) A piston-cylinder device operates 1 kg of fluid at 20 bar pressure. The initial volume is 0.04 m^3. The fluid is allowed to expand reversibly following a process $pV^{1.45} = C$ so that the volume becomes double. The fluid is then cooled at constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle.
2. (a) Show that the Kelvin-Planck statement and Clausius statement of second law of thermodynamics are equivalent.
   (b) Show mathematically that in a Carnot cycle, lowering the sink temperature is more effective than increasing the source temperature by same amount to increase the thermal efficiency.
   (c) In a steam power station, steam flows steadily through a 0.2 m diameter pipeline from the boiler to the turbine. At the boiler end, the steam conditions are found to be: p = 4 MPa, t = 400°C, h = 3213.6 kJ/kg, and v = 0.073 m^3/kg. At the turbine end, the conditions are found to be p = 3.5 MPa, t = 392°C, h = 3202.6 kJ/kg, and v = 0.084 m^3/kg, and v = 0.084 m^3/kg. There is heat loss of 8.5 kJ / kg from the pipeline. Calculate the steam flow rate.
3. (a) Consider a limited pressure cycle. Draw the cycle on p-V and T-s planes. Derive the expressions for the thermal efficiency and mean effective pressure of the cycle in terms of compression ratio, cut-off ratio, constant volume pressure ratio and the adiabatic index.
   (b) By drawing the cycles on p-V and T-s planes, compare Otto cycle, Diesel cycle and the Dual cycle on the basis of (i) same compression ratio and heat rejection and (ii) same maximum temperature and pressure and heat rejection.

SECOND HALF

*Answer any **THREE** questions*

4. (a) Name the different types of Lathe used in industries. Write short notes on Capstan and Turret Lathes.

   (b) List out the machining operations that can be performed on a Lathe.

   (c) With the help of neat sketches explain any three of the above operations.

5. (a) In how many ways taper turning operation can be performed on Lathe? With necessary sketch explain any one of them.

   (b) Determine the angle at which the compound rest should be swiveled when cutting a taper on a work with following dimensions:
   Total length L = 120 mm, length of the taper portion l = 80 mm, big end diameter D= 60 mm, small end diameter d = 20 mm.

   (c) It is required to cut a screw having 7 mm pitch on a Lathe having a 4 tpi lead screw. Calculate the gear ratio.

6. (a) Draw a neat sketch of a twist drill bit and label its various parts.

   (b) Write down the machining operations performed on drilling machine. Draw sketches of any three operations.

   (c) A through hole has to be made in a 20 mm thick mild steel plate. The drill bit diameter is 12 mm, rotational speed is 180 rpm and feed is 0.06 mm/ revolution. Considering the approach and over travel length 5 mm each, calculate the machining time.

7. (a) Write down the classification of milling machines.

   (b) Name the different milling operations.

   (c) With neat sketches describe the up milling and down milling methods.

8. (a) State the relationship between (i) feed per tooth (s_z), (ii) feed per revolution (s_r) and (iii) feed per minute (s_m) in milling operation.

   (b) Show that in plain milling operation, the approach length is given by: $L_o = \sqrt{t(D-t)}$; where, 't' is the depth of cut and 'D' is the cutter diameter.

   (c) Write short notes on any two of the following processes: (i) Face milling, (ii) Straddle milling and (iii) Angular milling.